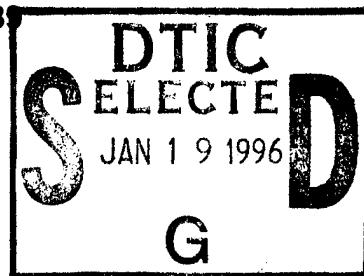




CARDIOVASCULAR RESPONSES TO VERY LONG DURATION POSITIVE PRESSURE BREATHING

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W. D. Fraser and K. N. Ackles

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Abstract

This study was undertaken to examine the effectiveness of the US Navy Enhanced Anti-G Lower Ensemble (EAGLE) and the US Air Force Advanced Tactical Anti-G System (ATAGS) enhanced coverage g-suits in providing protection against the adverse effects of positive pressure breathing and to establish the physiological duration limits of high levels of PPB. Six experienced subjects, wearing ATAGS and EAGLE g-suits and counter-pressure chest jerkins, were exposed to counterbalanced sessions of 60, 70, and 80 mmHg PPB for up to 20 minutes. They underwent an additional exposure at 70 mmHg PPB while wearing the Tactical Life Support System (TLSS) integrated g-suit and PPB jerkin. G-suit pressure was 4 times PPB jerkin and mask pressure. All six subjects completed 20 minutes of PPB with the ATAGS system at 60 and 70 mmHg and four subjects completed 80 mmHg PPB. Five of the subjects completed the 60 mmHg PPB session and four of the subjects completed the 70 and 80 mmHg PPB session with the EAGLE garment. Five of subjects completed the 70 mmHg PPB exposure with the TLSS garment. There were small, but statistically significant differences, in the changes in heart rate, stroke volume, cardiac index, and mean arterial blood pressure among the three garments with the TLSS garment providing better overall cardiovascular support at 70 mmHg PPB. The ability of some subjects to tolerate 80 mmHg of PPB for up to 20 minutes without difficulty indicates that the duration limit for this type of PPB exposure, with respect to either cardiovascular collapse or discomfort, has yet to be established.

Introduction

Previous studies [1, 2] have shown that the extended coverage of the bladders of the anti-G portion of the Tactical Life Support System (TLSS) provides superior protection against the adverse cardiovascular effects of positive pressure breathing (PPB) compared to the protection provided by the limited bladder coverage of the USAF CSU 13B/P G-suit of the Combined Advanced Technology Enhanced Design G Ensemble (Combat Edge or CE) system. The 45% greater bladder coverage of the lower body provided by the g-suit component of the TLSS, compared to the CSU 13B/P suit, was such that 12 subjects were able to withstand 10 minutes of 88 mmHg PPB while wearing the TLSS ensemble whereas only 5 subjects could complete the 10 minutes of 88 mmHg PPB while wearing the CE ensemble. In addition, the cardiac index was not depressed to the same degree with the TLSS system. This level of protection provides a large cardiovascular safety margin during the use of PPB for protection against hypoxia following rapid decompression to 60,000 ft [3].

TLSS was not developed for operational use, though the US Navy Enhanced Anti-G Lower Ensemble (EAGLE), the USAF Advanced Tactical Anti-G System (ATAGS), and the Canadian Sustained Tolerance Enhanced G (STING) anti-G systems are being considered for use in the operational environment for improving Gz protection. Though not explicitly designed for protection against the severe hypoxia following rapid decompression above 50,000 ft., the even greater lower body coverage provided by these garments should be as or more effective in providing protection against the adverse effects of long duration positive pressure breathing and thus be suitable for providing altitude protection.

In the TLSS/CE comparison study [1] a 10 minute maximum exposure had been established during discussions of the experimental design under the assumption that none of the subjects would actually complete the full 10 minutes due to either cardiovascular collapse or severe discomfort. Conventional wisdom states that painful tissue distortion in the neck and face becomes intolerable at breathing pressures in excess of 70 mmHg, such that a full pressure helmet is required [4]. Since most of the subjects in the previous study had only small decrements in cardiovascular function and tolerable levels of discomfort even after 10 minutes of PPB with the TLSS garment, the limits of human tolerance to very long duration PPB exposures have yet to be established.

This study was thus undertaken to examine the effectiveness of the ATAGS and EAGLE garments in protecting against the adverse effects of PPB and was a second attempt to establish the physiological duration limits of high levels of PPB.

Methods

Subjects

Two female and four male subjects took part in this experiment. All subjects gave written, informed consent in accordance with the guidelines of the DCIEM Human Ethics Committee and had passed the DCIEM medical examination for positive pressure breathing experiments. Their physical characteristics are given in Table 1. All had extensive experience with positive pressure breathing at up to 80 mmHg.

Table 1.
Physical Characteristics of Subjects

Subject	Sex	Age	Height (cm)	Weight (kg)
ael	F	29	166	63
jsm	M	37	178	72
mms	F	30	166	55
mrp	M	31	178	76
twg	M	25	193	89
wdf	M	40	187	99

Techniques

During the experiments the subject's blood pressure was monitored with a Finapres 2300 blood pressure waveform monitor (Ohmeda 2300, Canadian Oxygen Ltd., Rexdale, Ontario) with the blood pressure cuff on the left ring finger and the hand supported at heart level with a sling. Cardiac impedance waveforms were generated and monitored with a Minnesota Impedance Cardiograph, Model 304B (Surcom Inc. Minneapolis, Minn.) using two neck and two torso band electrodes [5]. The electrocardiogram was monitored with a modified Lead II configuration and a ECG amplifier (Model 13-415-58, Gould Inc., Instruments Division, Cleveland, Ohio). Mask cavity pressure was measured with a pressure transducer (Model PS309, Validyne Corp., Northridge, CA) and chamber altitude was monitored with a water filled glass manometer.

Procedures

Subjects were exposed to 60, 70, and 80 mmHg PPB for up to 20 minutes while wearing the US Navy EAGLE or USAF ATAGS lower garment, and the CF pressure jerkin. In addition, they underwent an additional exposure at 70 mmHg PPB while wearing the TLSS integrated garment. Subjects wore TLSS or CE helmets and masks (Gentex Corp., Carbondale PA) . The order of PPB level and garment was counterbalanced. The subjects wore the anti-g booties along with their anti-g suits with the ATAGS system but had no booties with the EAGLE and TLSS garments.

Prior to each experiment a finger-tip blood sample was taken for the measurement of hematocrit and body weight was recorded. ECG and impedance electrodes were attached and the subjects fitted with one of the three PPB ensembles. The subjects were then seated in the DCIEM altitude chamber and connected to the display and computer acquisition equipment. Cardiovascular data was collected for a 3 minute control period prior to the onset of PPB. PPB was produced by having the subjects breathe ambient air through the wall of the chamber with the chamber raised to a sufficient altitude to provide differential pressures of 60, 70, and 80 mmHg between the chamber interior and ambient air. PPB was initiated by activation of a solenoid valve connecting the subject's mask and the exterior of the chamber. G-suit inflation was initiated simultaneously by the run director with a separate solenoid valve connecting the g-suit to a regulated pressure supply. G-suit pressures were four times mask cavity pressure during all PPB exposures. PPB was initiated at the end of the 3 minute control period and continued until the subject requested termination; the medical officer or run director initiated a termination due to a fall in heart rate and/or mean arterial blood pressure of greater than 20% compared to the

heart rate or blood pressure after the initial onset of PPB or the appearance of other pre-syncopal symptoms; or the subject failed to respond to verbal and visual challenge which was given every minute with an auditory tone and a flashing light; or after a maximum exposure time of 20 minutes.

Physiological parameters

Electrocardiogram (ECG), Finapres blood pressure waveforms, cardiac impedance dz/dt and Zo waveforms, and mask and suit pressures were recorded during the three minute control period and during the PPB directly to computer disk with a Macintosh IIci (Apple Computer Corp. Cupertino, CA) computer running the LabViewsTM data collection and analysis package (National Instruments, Austin, TX) at a sampling rate of 100 Hz. The data was transferred via LAN to a Macintosh IIfx computer. In-house UNIX based processing software was used to automatically analyze all waveform data and calculate heart rate, stroke volume, cardiac index, Heather index, and mean arterial blood pressure on a beat-by-beat basis. See [1] for details. Thirty second averages of these parameters were calculated and transferred to the statistical package for further analysis.

Statistical analysis

A 1 factor (garment) by 2 regressor (PPB level and time following PPB onset) analysis of covariance (ANCOVA) was used to analyze the heart rate, blood pressure, stroke volume, cardiac index, and Heather Index data. Thirty second averages of the each parameter minus the mean value of the parameter over the 3 minutes of control were calculated and used in the statistical analysis. The general linear modeling (GLM) package SuperAnova (Abacus Concepts Inc. Berkeley, CA) running on a Macintosh IIfx (Apple Computer Corp. Cupertino,

CA) was used for all calculations. Main effects and interactions were deleted if they were not significant at the $P < 0.05$ level and the analysis was repeated.

Results

All six subjects completed 20 minutes of PPB with the ATAGS system at 60 and 70 mmHg PPB sessions and four subjects completed 80 mmHg PPB. Five of the subjects completed the 60 mmHg PPB session and four of the subjects completed the 70 and 80 mmHg PPB session with the EAGLE garment. Five of subjects completed the 70 mmHg PPB exposure with the TLSS garment. In all but one case the runs were aborted by the medical officer due a drop in the mean arterial pressure. In all but one of these cases the subjects felt they could have continued. In one case the subject aborted a TLSS run due to pain in the urinary bladder. One subject was responsible for five of the eight aborts. This same subject had the least PPB tolerance with the CE and TLSS garments in a previous study [1]. Appendix B. contains the tables of all the individual changes in cardiac parameters that occurred during positive pressure breathing. All parameters are expressed as absolute change from the average value of the parameter during the three minute control period prior to the onset of the positive pressure breathing. Values are averaged over 30 s intervals. Missing cells represent bad data or failure of the subject to complete the full 20 minutes of PPB exposure.

All three garments provided a high level of cardiovascular support with only small changes in heart rate and stroke volumes over the long-duration PPB exposures. For heart rate, there was a significant effect due to garment ($P < 0.0001$) and interaction between garment and PPB level ($P < 0.0001$) (Figure 1), and significant interaction between garment and time ($P < 0.0001$) (Figure 2) and

PPB and time ($P < 0.041$) (Figure 2). Heart rate initially decreased with the onset of PPB and then increased above baseline levels as PPB continued and stroke volume fell. For stroke volume, there was a significant effect of time ($P < 0.0001$) with a continuous decrease throughout the PPB exposure and a significant effect of garment ($P < 0.0001$) (Figure 3). For cardiac index, there was a significant effect due to garment ($P < 0.0043$) and a significant interaction between PPB and garment ($P < 0.0027$) (Figure 4), a significant effect due to time ($P < 0.0217$), significant interaction between garment and time ($P < 0.0010$) and PPB, time, and garment ($P < 0.0014$). There was a significant effect of PPB ($P < 0.0001$) and time ($P < 0.005$) (Figure 5) on the Heather Index, but no differences among the three garment types. There was a significant effect of PPB ($P < 0.0001$), garment ($P < 0.0001$) (Figure 6), and time ($P < 0.0071$) on mean arterial blood pressure as well as a significant interaction between PPB and garment ($P < 0.0001$), PPB and time ($P < 0.0036$) and garment and time ($P < 0.0001$).

Two side effects of long duration PPB were observed. At the cessation of PPB and anti-G suit pressure there was often a dramatic transient drop in the blood pressure of several subjects below control values resulting in partial loss of vision and near syncope. The medical officer requested that anti-G suit pressure of 50 mmHg be provided for several minutes following the cessation of PPB in those subjects who were the most susceptible to this transient blood pressure drop. In addition, almost all subjects, while wearing all three of the garments, experienced severe foot-pain, i.e., "pins-and-needles" as circulation to the feet returned to normal. This disappeared within two to three minutes after the cessation of PPB. Though this pain was distracting, it was not incapacitating, and the subjects were still able to concentrate on the serial choice reaction time performance task. Any movement or flexing of the feet during this time did

lead to much higher levels of pain and the subjects felt that precise movement of an aircraft's rudder pedals would be very difficult.

Discussion

Although there were statistically significant differences among the three garments with respect to changes in the cardiovascular function during the PPB, the small magnitude of these effects indicates that all three garments provide effective support during long duration PPB. The cardiovascular decrements that developed during the first 10 minutes of the PPB exposures in this study with TLSS ensembles, ATAGS, and EAGLE anti-G suits were similar to that observed after 10 minutes of PPB exposure with the TLSS garment in the previous study. There is evidence, however, that the approximately 80% lower body coverage provided by the ATAGS and EAGLE garments may not provide the same degree of cardiovascular support as does the older TLSS design with its approximately 55% lower body coverage. For the 70 mmHg PPB exposure with the TLSS garment the stroke volume was not depressed to the same degree and heart rate was increased. Overall heart rate and stroke volume decreased with the ATAGS and EAGLE leading to an overall decrease in cardiac index. The elevated heart rate with the TLSS garment resulted in a slightly elevated cardiac index when averaged over time. The greater coverage of the ATAGS and EAGLE may suppress the cardiovascular reflexes normally triggered by the fall in stroke volume and thus prevent any compensatory increase in heart rate. The greater stroke volume decrement with the ATAGS and EAGLE garments at 70 mmHg than at 80 mmHg PPB is likely due to an anti-G suit pressure of 320 mmHg compared to 280 mmHg at 70 mmHg PPB.

The ability of some of our subjects to tolerate 80 mmHg of PPB for up to 20 minutes without difficulty and the comments from a number of them that they could have continued with the exposure indicates that we have yet to establish the time limit for this type of PPB exposure with respect to either a cardiovascular or discomfort limit. All of our subjects described these exposures as very unpleasant and tiring, but they were able to perform well on a serial choice reaction time task throughout the 20 minutes of PPB exposure. It is possible that well trained subjects may be able to tolerate much higher levels of PPB for short periods of time without using a partial pressure helmet. The one subject who had difficulty completing the full 20 minutes of the higher levels of PPB with all of the systems was compromised in part by her small stature and the consequent difficulty in obtaining a proper fit with the G-suits.

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References

1. Goodman, L.S., *et al.*, Effect of extending G-suit coverage on cardiovascular responses to positive pressure breathing. *Aviat. Space Environ. Med.*, 1993. 64: p. 1101-1107.
2. Goodman, L.S., *et al.*, Cardiovascular responses to positive pressure breathing using the Tactical Life Support System. *Aviat. Space Environ. Med.*, 1992. (August): p. 662-669.
3. Fraser, W.D., *et al.*, Cardiovascular responses with standard and extended bladder coverage G-suits during rapid decompression. *Aviat. Space Environ. Med.*, 1994. 65: p. 209-213.
4. Ernsting, J., The Physiology of Pressure Breathing, in *A Textbook of Aviation Medicine*, J.A. Gillis, Editor. 1965, Permagon Press: Oxford. p. 343-373.
5. Denniston, J.C., *et al.*, Measurement of cardiac output by electrical impedance at rest and during exercise. *J. Appl. Physiol.*, 1976. 40: p. 91-95.
6. Buick, F. and J.A.G. Porlier, Oxyhemoglobin saturation following rapid decompression to 18,288 m preceded by diluted oxygen breathing. *Aviat. Space Environ. Med.*, 1991. 62(12): p. 1119-1126.
7. Ernsting, J., *et al.*, High altitude protection from pressure-breathing mask with trunk and lower limb counterpressure. *Aerosp. Med.*, 1960. 31: p. 41-48.
8. Ward, C.A., P. Tikuisis, and R.D. Venter, Stability of bubbles in a closed volume of liquid-gas solution. *J. of Appli. Physiol.*, 1982. 53(9): p. 6076-6084.
9. Ward, C.A., A.S. Tucker, and C.W. So, A bubble evolution method for diffusion coefficient measurements utilizing critical size concept. *J. Physi. Chem.*, 1979. 53: p. 543-550.

Appendix A.

Figures

Figure captions

Figure 1.

Change in heart rate for the different garments and levels of PPB. The change in heart rate is calculated with respect to the average heart rate over the three minutes of the control period. Results from all times, and all subjects are collapsed together to show the main effects of garment and PPB and the interaction between PPB and garment.

Figure 2.

Changes in heart rate over time for different garments. The change in heart rate is calculated with respect to the average heart rate over the three minutes of the control period. Results from all PPB levels and all subjects are collapsed together to show the main effects of garment and time.

Figure 3.

Change in stroke volume for the different garments and levels of PPB. The change in stroke volume is calculated with respect to the average stroke volume over the three minutes of the control period. Results from all times, and all subjects are collapsed together to show the main effects of garment and PPB and the interaction between PPB and garment.

Figure 4.

Change in cardiac index for the different garments and levels of PPB. The change in cardiac index is calculated with respect to the average cardiac index over the three minutes of the control period. Results from all times, and all subjects are collapsed together to show the main effects of garment and PPB and the interaction between PPB and garment.

Figure 5.

Change in Heather Index for the different times of PPB. The change in Heather Index is calculated with respect to the average Heather Index over the three minutes of the control period. Results from all PPB levels, all subjects, and all garments are collapsed together to show the main effects of time.

Figure 6.

Change in blood pressure for the different garments and levels of PPB. The change in blood pressure is calculated with respect to the average blood pressure over the three minutes of the control period. Results from all times, and all subjects are collapsed together to show the main effects of garment and PPB and the interaction between PPB and garment.

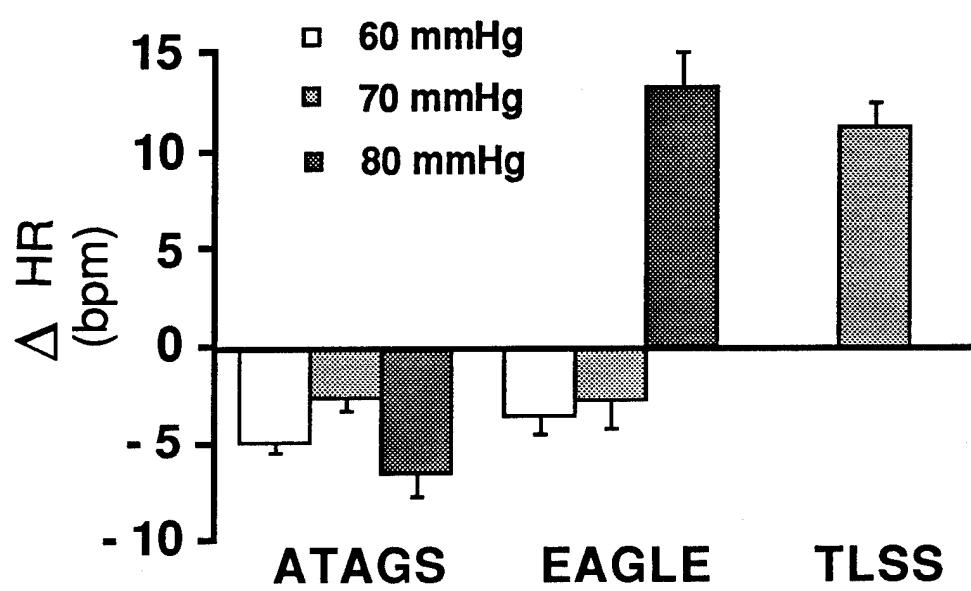
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Figure 2.

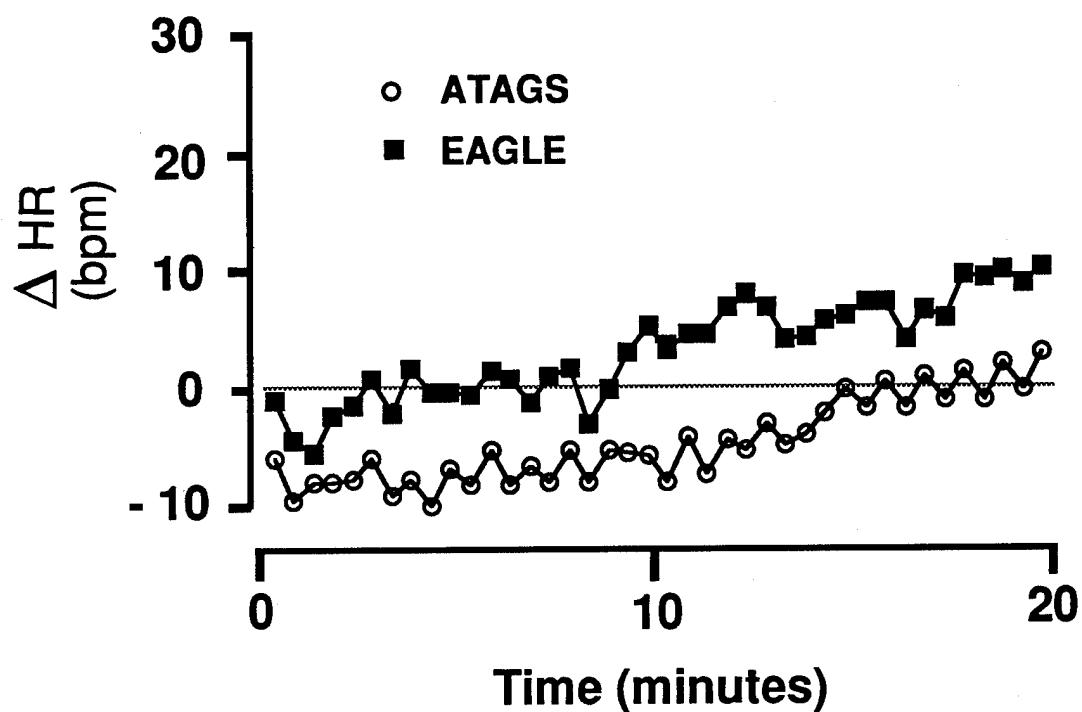


Figure 3.

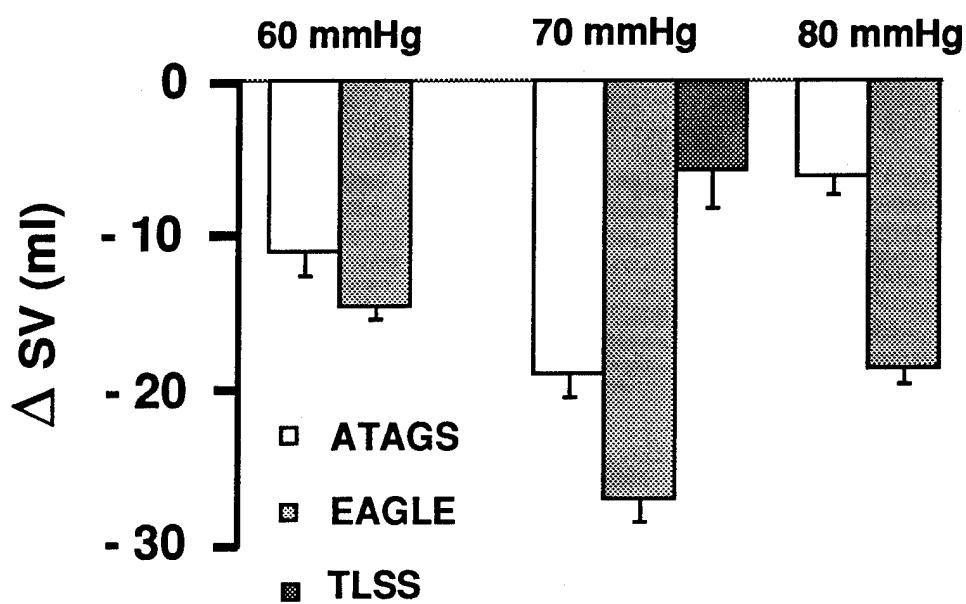


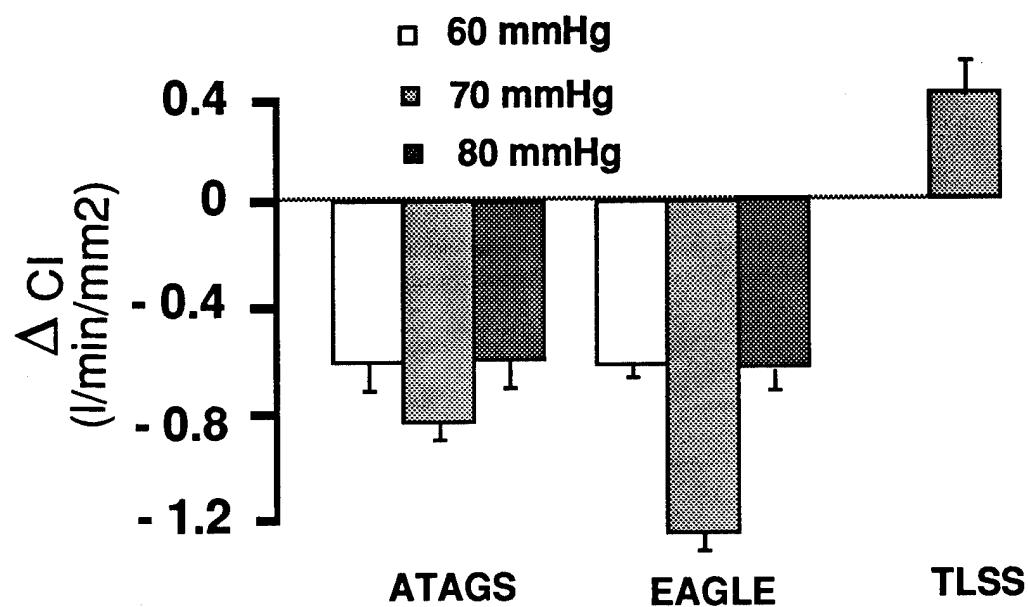
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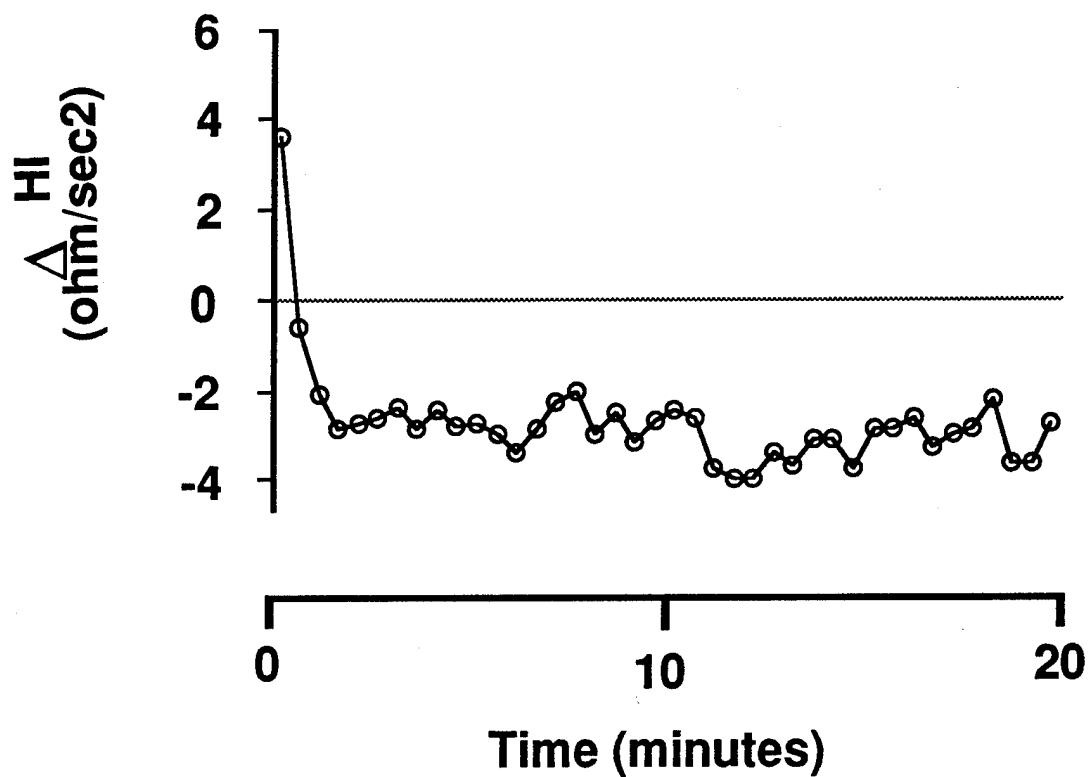
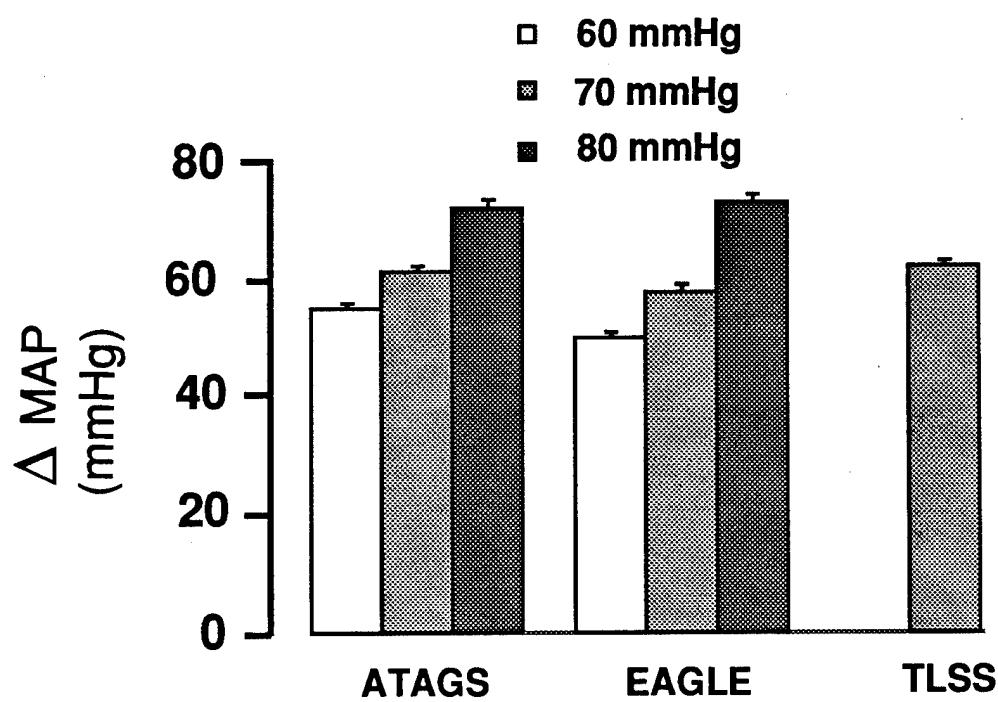
Figure 5.

Figure 6.



Appendix B.**Calculated change in cardiac indices for each subject****Key**

HR	Heart rate (bpm)
SV	Stroke volume (ml)
CI	Cardiac index (l/min/m ²)
MAP	Mean arterial pressure (mmHg)
SBP	Systolic blood pressure (mmHg)
DBP	Diastolic blood pressure (mmHg)

All parameters are expressed as absolute change from the average value of the parameter during the three minute control period prior to the onset of the positive pressure breathing. Values are averaged over 30 s intervals. Missing cells represent bad data or failure of the subject to complete the full 20 minutes of PPB exposure.

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 60 mmHg

Subject ael

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-12	11	-0.16	60	62	59
60	-15	12	-0.19	64	66	62
90	-17	8	-0.52	68	68	66
120	-16	15	-0.14	57	48	57
150	-15	2	-0.61	63	59	62
180	-12	1	-0.55	64	55	64
210	-16	7	-0.49	64	62	62
240	-8	-1	-0.46	58	47	59
270	-12	-2	-0.66	65	60	64
300	-9	-6	-0.70	58	49	60
330	-12	-3	-0.74	58	50	59
360	-6	-8	-0.71	64	57	64
390	-11	-5	-0.75	62	62	62
420	-10	-8	-0.83	54	45	56
450	-13	-5	-0.86	56	48	58
480	-8	-11	-0.90	52	41	55
510	-12	-9	-0.97	55	50	57
540	-7	-13	-0.93	55	49	57
570	-12	-11	-1.05	56	51	58
600	-9	-13	-1.03	54	43	57
630	-13	-10	-1.08	55	54	57
660	-8	-14	-1.04	55	48	58
690	-14	-9	-1.02	55	49	56
720	-8	-13	-0.98	51	40	54
750	-15	-8	-1.02	52	46	53
780	-12	-11	-1.05	51	43	54
810	-13	-8	-0.98	48	39	51
840	-9	-13	-1.01	50	38	54
870	-12	-10	-1.00	50	43	52
900	-7	-16	-1.09	48	37	52
930	-11	-11	-1.02	55	48	57
960	-5	-17	-1.06	52	45	55
990	-11	-12	-1.05	48	39	52
1020	-3	-21	-1.14	48	37	52
1050	-13	-12	-1.08	47	41	51
1080	-7	-16	-1.04	47	36	51
1110	-11	-15	-1.15	51	43	54
1140	-7	-18	-1.11	48	38	52
1170	-6	-18	-1.10	54	47	57
1200	-2	-12	-0.70	43	37	45

Change in cardiac parameters
Ground level PPB

Garment:	EAGLE						
PPB	60 mmHg						
Subject	ael	HR	SV	CI	MAP	SBP	DBP
		bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
	Time (s)						
	30	1	-1	0.02	37	27	38
	60	-12	2	-0.23	45	52	44
	90	-15	0	-0.37	52	60	51
	120	-15	0	-0.39	47	51	46
	150	-21	-1	-0.55	47	50	47
	180	-15	-2	-0.45	51	52	50
	210	-17	-3	-0.54	52	51	50
	240	-15	-1	-0.44	44	42	44
	270	-20	0	-0.52	51	51	49
	300	-21	0	-0.52	50	49	48
	330	-23	-2	-0.67	48	48	47
	360	-22	-1	-0.57	49	47	47
	390	-21	-2	-0.60	51	52	48
	420	-20	-2	-0.56	45	44	45
	450	-23	1	-0.57	46	46	45
	480	-23	0	-0.59	46	43	46
	510	-25	-1	-0.66	51	51	49
	540	-22	-1	-0.58	40	35	41
	570	-27	2	-0.62	44	42	43
	600	-25	1	-0.58	42	35	43
	630	-25	-1	-0.65	52	56	50
	660	-21	-1	-0.57	45	42	45
	690	-23	-1	-0.63	43	40	44
	720	-23	2	-0.53	40	30	41
	750	-27	0	-0.67	42	39	42
	780	-22	-1	-0.60	45	40	46
	810	-24	0	-0.61	46	43	45
	840	-23	-1	-0.60	44	34	45
	870	-24	-2	-0.66	50	48	48
	900	-21	-3	-0.63	43	37	43
	930	-21	-4	-0.67	47	43	47
	960	-21	-1	-0.57	45	37	45
	990	-23	-2	-0.65	44	38	44
	1020	-22	-2	-0.62	49	41	49
	1050	-20	-3	-0.60	49	47	48
	1080	-21	-2	-0.60	43	34	44
	1110	-21	-3	-0.64	47	42	46
	1140	-20	-5	-0.70	40	29	42
	1170	-21	-3	-0.64	44	38	45
	1200	-17	7	-0.15	39	28	40

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 70 mmHg

Subject ael

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	-10	11	0.06	56	50	56
60	-14	11	-0.17	65	64	62
90	-16	7	-0.39	62	60	60
120	-14	2	-0.57	69	67	65
150	-15	1	-0.61	70	69	67
180	-6	-4	-0.46	69	64	67
210	-15	2	-0.57	69	67	66
240	-10	-3	-0.57	71	68	68
270	-11	-5	-0.71	70	70	67
300	-7	-6	-0.59	69	66	67
330	-8	-8	-0.72	69	68	68
360	-7	-7	-0.66	67	64	67
390	-12	-5	-0.75	66	63	65
420	-9	-7	-0.72	67	66	67
450	-15	-5	-0.86	61	58	61
480	-14	-5	-0.81	62	57	62
510	-13	-7	-0.86	66	64	66
540	-14	-4	-0.79	66	63	65
570	-16	-6	-0.95	62	62	61
600	-10	-8	-0.77	64	58	65
630	-12	0	-0.60	62	59	63
660	-9	-8	-0.77	60	51	62
690	-13	-6	-0.85	64	62	65
720	-9	-9	-0.81	61	56	63
750	-12	-5	-0.74	61	57	63
780	-8	-10	-0.82	62	59	64
810	-9	-8	-0.78	60	59	61
840	-9	-9	-0.80	61	61	61
870	-17	-3	-0.88	57	56	57
900	-8	-12	-0.89	57	55	58
930	-10	-7	-0.79	58	60	58
960	-3	-15	-0.85	55	54	56
990	-9	-10	-0.82	54	55	55
1020	-7	-11	-0.83	49	44	51
1050	-11	-10	-0.92	54	55	55
1080	-8	-15	-1.00	55	54	56
1110	-18	-4	-0.96	51	50	52
1140	-10	-12	-0.93	56	52	56
1170	-11	-3	-0.66	55	55	55
1200	-5	-10	-0.67	41	39	41

Change in cardiac parameters
Ground level PPB

Garment: EAGLE

PPB 70 mmHg

Subject ael

	HR	SV	CI	MAP	SBP	DBP
Time (s)	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
30	-13	3	-0.29	47	47	49
60	-24	5	-0.59	62	71	59
90	-26	5	-0.66	57	66	56
120	-25	2	-0.76	64	72	61
150	-26	4	-0.72	61	70	59
180	-23	-1	-0.77	62	71	59
210	-28	4	-0.77	63	73	58
240	-26	1	-0.80	67	79	61
270	-25	-1	-0.86	66	78	62
300	-27	7	-0.65	65	76	60
330	-29	17	-0.34	63	75	59
360	-25	4	-0.65	61	68	57
390	-29	5	-0.79	63	77	58
420	-29	4	-0.79	62	74	58
450	-26	3	-0.73	59	70	56
480	-27	6	-0.70	60	66	55
510	-28	-2	-0.99	61	72	57
540	-26	-4	-0.97	60	69	56
570	-26	-2	-0.90	57	67	54
600	-22	-4	-0.85	59	64	56
630	-23	-5	-0.94	59	69	56
660	-23	-3	-0.83	59	68	56
690	-24	-4	-0.93	56	65	53
720	-22	-7	-0.98	62	70	58
750	-25	-6	-1.03	58	69	56
780	-22	-9	-1.06	59	65	56
810	-23	-9	-1.09	56	65	54
840	-24	-8	-1.06	58	68	55
870	-26	-9	-1.16	57	69	53
900	-23	-9	-1.07	59	68	56
930	-20	-8	-0.97	53	61	52
960	-20	-10	-1.04	56	59	52
990	-24	-10	-1.15	57	66	54
1020	-21	-7	-0.97	57	60	53
1050	-21	-3	-0.82	54	59	51
1080	-19	-4	-0.76	56	59	53
1110	-19	-11	-1.07	55	60	53
1140	-19	-13	-1.13	52	51	50
1170	-16	-3	-0.66	56	63	55
1200	-12	-1	-0.46	52	54	51

Change in cardiac parameters
Ground level PPB

Garment: TLSS
PPB 70 mmHg
Subject ael

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	-11	8	-0.64	61	57	64
60	-19	32	-0.41	78	85	78
90	-20	42	-0.16	77	84	78
120	-15	6	-1.14	78	83	81
150	-11	22	0.03	77	78	81
180	-8	26	0.44	84	87	86
210	-10	18	-0.21	80	86	82
240	-5	21	0.42	80	85	83
270	-10	1	-0.92	72	82	74
300	-7	26	0.52	73	79	75
330	-5	6	-0.29	71	78	74
360	-8	14	-0.12	70	74	74
390	-7	13	-0.20	68	70	71
420	-10	2	-0.98	69	69	73
450	-5	11	0.02	71	74	74
480	-7	14	0.01	69	69	73
510	-11	27	0.17	71	75	73
540	-7	8	-0.14	64	65	68
570	-6	3	-0.52	62	64	66
600	-7	-13	-1.30	60	58	65
630	-4	11	0.30	62	62	67
660	-5	15	0.20	60	60	65
690	-7	13	-0.04	55	49	60
720	-8	19	0.21	54	47	61
750	-8	5	-0.52	60	56	65
780	-3	-6	-0.68	57	52	63
810	-7	77	3.09	57	54	62
840	-4	29	1.15	55	48	61
870	-7	34	1.01	59	56	65
900	-5	24	0.74	59	54	64
930	-10	34	0.67	53	47	59
960	-8	33	0.93	57	49	64
990	-9	37	0.95	62	57	66
1020	-3	14	0.47	62	56	68
1050	-12	33	0.42	52	43	59
1080	-2	15	0.60	57	47	64
1110	-8	30	0.74	62	57	68
1140	0	2	0.17	61	51	68
1170	-5	14	0.30	67	61	74
1200	-1	8	0.41	52	46	57

Change in cardiac parameters
Ground level PPB

Garment: ATAGS
PPB 80 mmHg
Subject ael

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	-16	17	0.09	88	100	84
60	-24	19	-0.18	96	110	90
90	-24	16	-0.31	93	102	88
120	-21	10	-0.41	99	105	91
150	-20	13	-0.26	95	99	89
180	-18	7	-0.42	91	92	85
210	-19	8	-0.40	91	99	84
240	-16	5	-0.45	88	94	81
270	-20	5	-0.59	86	93	80
300	-20	7	-0.50	84	90	78
330	-17	4	-0.47	86	96	80
360	-14	2	-0.45	81	86	76
390	-18	3	-0.58	85	92	80
420	-16	15	0.06	85	88	81
450	-20	5	-0.60	83	90	79
480	-12	0	-0.50	82	85	80
510	-18	1	-0.63	86	97	82
540	-17	2	-0.58	82	88	79
570	-22	2	-0.77	82	94	78
600	-18	0	-0.69	80	85	78
630	-21	3	-0.71	84	96	81
660	-15	-3	-0.73	85	94	82
690	-19	-1	-0.81	81	92	78
720	-19	0	-0.75	80	86	79
750	-18	-1	-0.77	80	94	78
780	-20	-1	-0.81	82	93	80
810	-22	2	-0.80	75	82	73
840	-20	0	-0.79	78	85	75
870	-19	-2	-0.80	81	95	78
900	-19	-2	-0.80	77	87	75
930	-19	-4	-0.92	78	95	76
960	-15	-8	-0.90	79	91	78
990	-18	-5	-0.88	78	91	76
1020	-17	-7	-0.93	73	81	73
1050	-19	-4	-0.90	77	92	73
1080	-15	-8	-0.91	72	83	72
1110	-16	-6	-0.90	77	90	75
1140	-11	-11	-0.92	74	85	74
1170	-17	-8	-1.02	78	91	77
1200	-6	-7	-0.56	65	74	64

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 80 mmHg

Subject ael

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-15	1	-0.69	68	82	62
60	-22	-6	-1.35	78	99	73
90	-30	-5	-1.69	80	99	75
120	-27	-8	-1.72	78	94	76
150	-29	-9	-1.81	81	97	79
180	-28	-10	-1.78	80	95	77
210	-32	-8	-1.94	85	105	80
240	-29	-12	-1.91	87	108	82
270	-32	-12	-2.06	88	111	84
300	-33	-11	-2.03	82	100	80
330	-34	-13	-2.16	86	100	85
360	-33	-11	-2.06	81	94	81
390	-34	-12	-2.13	86	101	84
420	-32	-12	-2.03	81	92	79
450	-34	-16	-2.23	81	91	80
480	-32	-13	-2.10	77	84	77
510	-32	-17	-2.22	76	85	76
540	-30	-12	-1.94	73	77	73
570	-33	-12	-2.10	72	80	72
600	-30	-15	-2.06	71	74	73
630	-32	-13	-2.10	76	85	76
660	-26	-14	-1.85	66	68	69
690	-30	-15	-2.04	71	77	72
720	-26	-16	-1.92	67	69	69
750	-29	-19	-2.14	67	72	68
780	-25	-18	-1.97	63	65	66
810	-27	-17	-2.01	65	68	68
840	-19	-22	-1.87	65	61	69
870	-25	-19	-1.99	60	55	66
900	-19	-26	-2.02	60	50	67
930	-22	-23	-2.02	61	55	67
960	-17	-27	-2.01	55	42	61
990	-20	-24	-1.99	56	46	62
1020	-10	-31	-1.97	51	38	57
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 60 mmHg

Subject jsm

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	-2	8	0.31	60	52	60
60	-3	2	0.02	63	61	64
90	-3	-1	-0.09	64	59	65
120	-7	0	-0.15	64	51	68
150	-6	-1	-0.17	58	51	62
180	-7	-3	-0.24	57	47	62
210	-5	-4	-0.23	59	55	62
240	-4	-4	-0.25	59	54	60
270	-6	-4	-0.27	59	55	61
300	-4	-5	-0.30	57	52	61
330	-1	-6	-0.30	55	54	58
360	-3	-6	-0.31	54	50	56
390	-1	-7	-0.31	50	54	51
420	1	-7	-0.32	46	50	47
450	2	-6	-0.26	52	56	53
480	2	-8	-0.34	53	56	55
510	0	-5	-0.25	59	65	60
540	1	-8	-0.35	59	61	62
570	2	-9	-0.36	60	68	62
600	1	-9	-0.39	63	70	64
630	1	-9	-0.39	61	66	64
660	-1	-9	-0.41	62	67	63
690	0	-9	-0.41	60	67	62
720	1	-10	-0.42	63	69	64
750	2	-9	-0.41	55	57	58
780	6	-10	-0.39	60	67	60
810	4	-9	-0.35	61	68	62
840	3	-10	-0.40	62	67	64
870	2	-10	-0.43	57	60	59
900	5	-11	-0.43	59	63	61
930	0	-7	-0.30	56	62	58
960	5	-6	-0.23	58	61	59
990	4	-7	-0.27	60	66	62
1020	5	-6	-0.21	62	67	63
1050	8	-7	-0.21	58	63	59
1080	6	-5	-0.14	61	66	62
1110	3	-7	-0.29	56	61	58
1140	8	-8	-0.24	60	63	61
1170	3	-6	-0.25	61	68	63
1200	0	-4	-0.17	60	64	61

Change in cardiac parameters

Ground level PPB

Garment: EAGLE

PPB 60 mmHg

Subject jsm

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	2	-3	-0.08	49	59	48
60	4	-6	-0.15	56	63	57
90	1	-5	-0.18	50	54	52
120	6	-6	-0.09	53	56	54
150	6	-7	-0.15	56	63	56
180	8	-8	-0.13	58	63	58
210	6	-9	-0.24	54	55	55
240	8	-8	-0.14	59	63	59
270	6	-10	-0.27	56	59	57
300	7	-10	-0.23	62	66	61
330	8	-10	-0.23	64	71	64
360	8	-12	-0.31	65	72	64
390	7	-11	-0.32	63	70	64
420	9	-12	-0.31	61	65	61
450	9	-13	-0.36	62	68	63
480	11	-13	-0.30	65	70	65
510	9	-13	-0.35	61	63	62
540	13	-14	-0.34	69	77	68
570	10	-14	-0.37	66	71	66
600	11	-15	-0.38	65	67	65
630	11	-15	-0.41	68	73	68
660	12	-15	-0.39	68	72	69
690	11	-14	-0.39	67	73	68
720	13	-16	-0.43	65	65	65
750	10	-15	-0.44	64	64	65
780	14	-16	-0.41	72	78	72
810	14	-16	-0.37	69	73	69
840	16	-17	-0.40	69	74	68
870	14	-16	-0.40	67	72	68
900	16	-17	-0.38	70	73	70
930	17	-17	-0.37	76	85	75
960	16	-15	-0.29	79	87	78
990	16	-16	-0.36	79	87	78
1020	18	-18	-0.41	76	82	76
1050	17	-19	-0.47	77	83	77
1080	17	-19	-0.45	77	85	76
1110	15	-16	-0.35	80	88	80
1140	20	-14	-0.21	79	89	79
1170	18	-19	-0.46	75	82	75
1200	14	-12	-0.34	61	69	59

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 70 mmHg

Subject jsm

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	3	-3	-0.03	54	35	58
60	-3	-1	-0.14	69	57	72
90	-2	-3	-0.19	73	58	77
120	0	-3	-0.13	71	67	74
150	-1	-4	-0.20	73	65	75
180	2	-5	-0.17	74	68	76
210	1	-6	-0.20	70	66	73
240	4	-7	-0.21	69	66	72
270	1	-5	-0.18	74	69	76
300	5	-10	-0.30	79	76	80
330	2	-11	-0.41	79	75	80
360	4	-9	-0.30	78	77	78
390	1	-10	-0.39	76	75	77
420	6	-10	-0.30	77	79	77
450	6	-11	-0.34	75	78	75
480	7	-9	-0.22	72	74	72
510	6	-10	-0.31	72	75	71
540	7	-12	-0.32	74	79	73
570	7	-11	-0.31	71	73	70
600	2	-10	-0.40	70	78	69
630	8	-13	-0.35	69	73	69
660	10	-13	-0.31	72	78	71
690	7	-14	-0.44	71	76	71
720	8	-14	-0.44	71	74	70
750	5	-12	-0.41	68	73	68
780	12	-15	-0.38	73	75	72
810	11	-14	-0.35	74	75	74
840	12	-16	-0.41	75	75	75
870	10	-15	-0.43	73	75	74
900	13	-11	-0.19	76	78	76
930	10	-15	-0.41	73	75	73
960	11	-15	-0.37	72	71	72
990	11	-16	-0.46	70	69	71
1020	12	-16	-0.44	75	75	75
1050	12	-16	-0.44	73	72	73
1080	15	-18	-0.45	75	74	74
1110	14	-16	-0.41	74	74	74
1140	13	-16	-0.40	76	75	76
1170	9	-15	-0.44	75	75	76
1200	8	-8	-0.24	59	54	59

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
 PPB 70 mmHg
 Subject jsm

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	10	-11	-0.26	51	57	52
60	8	-13	-0.38	66	73	68
90	6	-13	-0.44	67	71	69
120	7	-13	-0.45	67	71	69
150	5	-13	-0.49	60	63	63
180	10	-15	-0.48	65	64	66
210	7	-16	-0.57	63	62	65
240	12	-18	-0.56	66	69	67
270	9	-18	-0.64	62	63	64
300	15	-17	-0.44	69	71	70
330	12	-18	-0.59	63	65	65
360	16	-20	-0.58	66	69	68
390	13	-18	-0.57	63	58	66
420	16	-20	-0.62	72	74	73
450	16	-20	-0.63	66	63	68
480	15	-22	-0.75	70	68	72
510	17	-23	-0.72	67	63	69
540	20	-24	-0.71	72	67	74
570	16	-23	-0.76	67	63	69
600	18	-24	-0.74	69	63	71
630	19	-22	-0.67	66	65	68
660	19	-21	-0.56	65	66	67
690	22	-21	-0.52	64	61	67
720	30	-23	-0.50	62	60	65
750	55	-17	-0.20	62	63	64
780	25	-21	-0.50	64	66	66
810	23	-22	-0.63	60	55	63
840	24	-25	-0.75	61	50	65
870	21	-22	-0.63	66	60	69
900	24	-25	-0.69	64	53	68
930	37	-25	-0.76	69	62	71
960	22	-24	-0.75	68	63	70
990	•	-41	-0.83	83	85	88
1020	•	-41	-0.90	85	88	89
1050	•	-39	-0.84	85	88	89
1080	•	-41	-0.99	88	93	92
1110	•	-39	-0.87	88	91	92
1140	•	-41	-0.97	86	90	90
1170	•	-39	-0.99	87	92	91
1200	•	-31	-0.51	72	77	73

Change in cardiac parameters
Ground level PPB

Garment: TLSS

PPB 70 mmHg

Subject jsm

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	8	0	0.34	58	57	59
60	2	-5	-0.16	70	72	73
90	-2	0	-0.15	74	83	78
120	3	-8	-0.24	80	86	82
150	4	-9	-0.27	77	89	78
180	5	-11	-0.33	79	86	81
210	2	-11	-0.43	83	92	86
240	4	-12	-0.39	82	87	84
270	•	-16	-0.60	84	89	87
300	3	-14	-0.52	85	94	88
330	5	-18	-0.67	87	98	90
360	7	-19	-0.64	86	95	88
390	7	-18	-0.59	82	92	84
420	11	-19	-0.52	87	96	89
450	10	-21	-0.64	87	97	89
480	11	-20	-0.56	87	97	89
510	12	-24	-0.71	89	99	91
540	14	-22	-0.54	86	97	87
570	14	-21	-0.57	83	91	86
600	14	-23	-0.60	85	94	87
630	12	-22	-0.67	84	93	87
660	13	-22	-0.61	86	94	89
690	13	-23	-0.67	86	98	89
720	14	-25	-0.74	88	97	91
750	15	-26	-0.75	88	96	91
780	14	-26	-0.77	86	94	89
810	14	-26	-0.76	88	95	91
840	16	-29	-0.85	86	94	89
870	16	-28	-0.82	89	95	93
900	16	-29	-0.87	87	94	90
930	17	-28	-0.80	84	89	88
960	18	-30	-0.89	84	88	88
990	•	•	•	•	•	•
1020	•	•	•	•	•	•
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 80 mmHg

Subject jsm

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	11	•	•	58	46	57
60	0	•	•	74	64	74
90	-1	•	•	80	75	81
120	-2	•	•	81	79	81
150	-2	•	•	84	80	86
180	1	•	•	84	83	84
210	-1	•	•	80	79	80
240	1	•	•	84	86	83
270	0	•	•	78	75	79
300	0	•	•	82	81	81
330	0	•	•	81	79	82
360	-1	•	•	83	83	83
390	0	•	•	81	80	81
420	1	•	•	84	83	83
450	2	•	•	81	79	81
480	3	•	•	81	80	81
510	5	•	•	81	79	82
540	8	•	•	82	80	83
570	5	•	•	72	64	73
600	9	•	•	79	74	80
630	8	•	•	77	71	79
660	9	•	•	79	72	81
690	11	•	•	81	74	83
720	10	•	•	80	73	82
750	10	•	•	78	69	80
780	11	•	•	82	74	84
810	11	•	•	78	69	81
840	11	•	•	79	71	81
870	8	•	•	75	65	77
900	12	•	•	77	69	80
930	10	•	•	76	67	79
960	11	•	•	77	69	80
990	12	•	•	73	62	77
1020	11	•	•	76	65	79
1050	11	•	•	74	61	78
1080	11	•	•	73	60	76
1110	10	•	•	73	59	77
1140	12	•	•	76	64	80
1170	10	•	•	71	57	76
1200	5	•	•	58	47	59

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 80 mmHg

Subject	jsm	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
		Time (s)					
		30	9	-6	67	73	67
		60	13	-5	84	92	85
		90	4	-10	83	93	84
		120	8	-13	84	93	86
		150	7	-14	87	96	88
		180	10	-13	75	79	80
		210	11	-16	80	89	81
		240	12	-16	37	67	74
		270	12	-17	71	77	76
		300	12	-18	101	71	92
		330	16	-19	67	80	80
		360	15	-19	93	101	93
		390	16	-19	83	87	84
		420	16	-19	84	91	86
		450	18	-20	88	97	90
		480	19	-22	92	103	93
		510	19	-21	86	94	88
		540	23	-20	93	103	94
		570	24	-22	95	106	96
		600	26	-22	96	107	96
		630	26	-23	99	109	100
		660	27	-24	98	108	99
		690	26	-23	101	111	102
		720	30	-24	105	117	105
		750	30	-24	104	115	104
		780	29	-22	104	113	105
		810	30	-24	106	116	107
		840	29	-25	105	112	107
		870	28	-25	108	118	109
		900	25	-17	103	110	105
		930	27	-26	105	110	106
		960	30	-23	108	113	109
		990	27	-25	103	108	105
		1020	28	-25	107	113	109
		1050	27	-25	105	111	107
		1080	28	-24	103	105	105
		1110	33	-25	99	105	100
		1140	33	-23	104	109	105
		1170	31	-26	99	101	100
		1200	26	-16	87	92	87

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 60 mmHg

Subject mms

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-19	5	-0.85	27	24	28
60	-17	4	-0.79	42	43	41
90	-17	-7	-1.51	55	60	55
120	-12	-16	-1.65	55	54	56
150	-26	2	-1.69	52	53	52
180	-34	8	-2.09	57	59	55
210	-13	-11	-1.89	55	54	55
240	-12	-24	-2.11	56	51	58
270	-25	-2	-1.80	61	58	60
300	-21	21	-0.33	63	58	63
330	-21	4	-1.24	60	59	60
360	-19	-11	-2.06	61	55	60
390	-24	-23	-2.66	61	56	61
420	-19	-20	-2.13	62	58	62
450	-29	27	-0.88	61	62	59
480	-26	16	-1.07	64	64	62
510	-11	-16	-1.36	56	50	58
540	-17	-16	-2.13	62	60	62
570	-15	-18	-1.68	61	57	62
600	-20	-6	-1.50	61	57	62
630	-29	5	-1.83	58	57	57
660	-23	-16	-2.25	54	51	56
690	-23	-11	-2.04	59	57	59
720	-19	-21	-2.18	61	59	62
750	-10	-16	-1.17	55	48	58
780	-19	-31	-2.67	58	52	60
810	-19	-9	-1.61	58	54	61
840	-12	-18	-1.49	57	48	61
870	-15	-22	-1.96	58	49	61
900	-16	-42	-2.97	58	48	62
930	-19	-40	-3.10	60	56	61
960	-21	-37	-3.07	63	58	64
990	-20	-32	-2.77	60	56	61
1020	-20	-38	-3.05	64	59	65
1050	7	-52	-3.25	60	54	61
1080	30	-44	-1.81	57	45	62
1110	1	-42	-3.10	62	57	63
1140	-21	-38	-3.12	65	60	66
1170	-19	-38	-3.00	59	55	61
1200	-14	-38	-2.69	57	49	59

Change in cardiac parameters
Ground level PPB

Garment: EAGLE

PPB 60 mmHg

Subject mms

	HR	SV	CI	MAP	SBP	DBP
Time (s)	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
30	-9	3	-0.35	38	38	40
60	-9	-6	-0.72	47	48	50
90	-7	-8	-0.77	47	45	51
120	-8	-10	-0.90	50	46	54
150	-12	-9	-1.02	46	43	50
180	-11	-11	-1.11	47	42	51
210	-14	-11	-1.19	47	44	50
240	-2	-16	-1.11	47	39	52
270	-4	-16	-1.13	41	33	46
300	-1	-19	-1.20	50	43	55
330	1	-18	-1.17	49	43	54
360	3	-21	-1.19	52	47	56
390	1	-21	-1.31	50	43	54
420	3	-20	-1.16	53	49	57
450	4	-22	-1.27	49	41	53
480	5	-24	-1.36	51	44	55
510	3	-22	-1.30	51	44	55
540	0	-19	-1.24	52	48	56
570	9	-25	-1.26	49	41	53
600	10	-23	-1.13	46	39	50
630	6	-23	-1.24	47	42	52
660	8	-22	-1.12	48	45	51
690	12	-26	-1.29	43	34	47
720	15	-27	-1.28	43	33	47
750	10	-25	-1.22	42	34	46
780	10	-26	-1.31	37	29	41
810	-7	-15	-1.19	25	19	30
840	-12	3	-1.02	1	-10	7
870	•	•	•	•	•	•
900	•	•	•	•	•	•
930	•	•	•	•	•	•
960	•	•	•	•	•	•
990	•	•	•	•	•	•
1020	•	•	•	•	•	•
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 70 mmHg

Subject mms

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-10	25	0.38	40	42	39
60	-15	11	-0.71	58	62	56
90	-16	4	-1.16	61	67	58
120	-12	-14	-1.58	62	68	60
150	-16	-2	-1.34	59	66	58
180	-12	-15	-1.56	63	68	62
210	-16	-7	-1.61	61	68	60
240	-11	-22	-1.87	65	70	64
270	-13	-18	-1.84	63	69	62
300	-12	-20	-1.80	63	68	63
330	-13	-16	-1.76	57	63	58
360	-11	-24	-2.04	57	62	58
390	-12	-27	-2.20	60	65	61
420	-10	-31	-2.17	60	64	61
450	-10	-30	-2.07	53	57	55
480	-10	-29	-2.11	57	61	58
510	-10	-34	-2.34	56	59	57
540	-7	-35	-2.37	57	60	59
570	-11	-29	-2.20	52	57	53
600	-9	-38	-2.40	52	54	55
630	-9	-36	-2.31	49	52	52
660	-9	-45	-2.68	57	58	60
690	-5	-42	-2.45	55	57	57
720	-5	-41	-2.48	54	56	57
750	-4	-46	-2.54	50	51	53
780	-4	-49	-2.62	53	53	57
810	-2	-46	-2.52	51	52	54
840	-3	-51	-2.85	55	55	58
870	-3	-49	-2.65	56	57	59
900	-3	-50	-2.70	57	58	60
930	-10	-43	-2.74	58	61	60
960	-6	-47	-2.76	64	65	66
990	-7	-47	-2.80	63	66	65
1020	-3	-49	-2.84	68	71	70
1050	-4	-49	-2.68	64	68	67
1080	-4	-48	-2.87	71	74	73
1110	-4	-51	-2.82	67	71	69
1140	-2	-52	-2.76	71	74	73
1170	-2	-53	-2.79	71	75	74
1200	5	-58	-3.27	65	70	65

Change in cardiac parameters
Ground level PPB

Garment: EAGLE

PPB 70 mmHg

Subject mms

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	-3	-11	-0.80	41	42	43
60	-10	-11	-1.06	48	50	50
90	-3	-13	-0.93	42	40	45
120	-2	-13	-0.90	39	35	42
150	-3	-15	-1.11	34	31	39
180	7	-21	-1.12	29	23	33
210	4	-16	-0.95	28	21	32
240	10	-24	-1.29	28	19	33
270	1	-19	-1.21	29	20	35
300	-6	-21	-1.58	23	13	29
330	-5	-18	-1.33	19	8	25
360	-7	-20	-1.49	21	12	27
390	•	•	•	•	•	•
420	-10	-1	-0.45	•	•	•
450	•	-13	•	45	34	53
480	•	-11	•	47	37	55
510	•	-11	•	38	26	47
540	•	-4	•	36	24	45
570	•	•	•	•	•	•
600	•	•	•	•	•	•
630	•	•	•	•	•	•
660	•	•	•	•	•	•
690	•	•	•	•	•	•
720	•	•	•	•	•	•
750	•	•	•	•	•	•
780	•	•	•	•	•	•
810	•	•	•	•	•	•
840	•	•	•	•	•	•
870	•	•	•	•	•	•
900	•	•	•	•	•	•
930	•	•	•	•	•	•
960	•	•	•	•	•	•
990	•	•	•	•	•	•
1020	•	•	•	•	•	•
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

Change in cardiac parameters
Ground level PPB

Garment: TLSS
PPB 70 mmHg
Subject mms

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-8	9	0.13	61	61	63
60	-22	14	-0.28	71	77	73
90	-8	6	-0.05	71	74	73
120	-2	-2	-0.21	67	68	70
150	-10	1	-0.34	61	62	65
180	-11	2	-0.32	59	58	64
210	-15	0	-0.54	54	53	58
240	-13	-1	-0.53	49	44	55
270	-14		-0.57	53	50	59
300	-2	-10	-0.61	51	41	58
330	-9	-10	-0.85	52	46	58
360	-3	-13	-0.79	54	45	61
390	-5	-8	-0.74	53	46	59
420	-4	-15	-0.97	51	40	58
450	•	•	•	•	•	•
480	•	•	•	•	•	•
510	•	•	•	•	•	•
540	•	•	•	•	•	•
570	•	•	•	•	•	•
600	•	•	•	•	•	•
630	•	•	•	•	•	•
660	•	•	•	•	•	•
690	•	•	•	•	•	•
720	•	•	•	•	•	•
750	•	•	•	•	•	•
780	•	•	•	•	•	•
810	•	•	•	•	•	•
840	•	•	•	•	•	•
870	•	•	•	•	•	•
900	•	•	•	•	•	•
930	•	•	•	•	•	•
960	•	•	•	•	•	•
990	•	•	•	•	•	•
1020	•	•	•	•	•	•
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 80 mmHg

Subject mms

	HR	SV	CI	MAP	SBP	DBP
Subject	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	-23	•	•	43	46	43
60	-23	•	•	62	69	64
90	-21	•	•	63	70	66
120	-22	-1	-1.12	60	57	64
150	-31	10	-0.90	59	55	62
180	-10	-13	-1.21	60	52	65
210	-9	-12	-1.36	62	58	66
240	-21	-7	-1.30	61	53	66
270	-24	-11	-1.60	63	57	67
300	-21	-12	-1.61	61	52	65
330	-16	-12	-1.47	59	51	63
360	-18	-16	-1.77	61	51	66
390	-15	-20	-1.70	61	53	68
420	-13	-25	-1.93	62	52	68
450	-20	-21	-1.91	58	55	64
480	-11	-24	-1.99	60	50	66
510	-20	-21	-1.91	59	50	65
540	-16	-22	-1.78	60	48	67
570	-5	-27	-1.97	59	53	64
600	-15	-24	-1.85	55	44	62
630	-16	-25	-2.01	52	44	59
660	-5	-22	-1.64	54	42	61
690	-23	-19	-1.93	60	53	65
720	-7	-24	-1.70	57	41	64
750	-16	-22	-1.82	53	41	61
780	-15	-20	-1.60	49	38	57
810	-17	-17	-1.60	52	39	59
840	-10	-17	-1.41	43	25	51
870	-7	-8	-1.07	41	23	49
900	-8	-7	-0.33	33	14	42
930	•	•	•	•	•	•
960	•	•	•	•	•	•
990	•	•	•	•	•	•
1020	•	•	•	•	•	•
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 80 mmHg
Subject mms

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	-4	-21	-1.41	50	48	54
60	1	-21	-1.34	56	55	61
90	-21	-17	-1.69	55	55	59
120	-9	-23	-1.68	55	49	60
150	-4	-23	-1.59	52	47	58
180	3	-22	-1.36	50	42	55
210	-3	-22	-1.48	44	36	49
240	0	-22	-1.40	37	24	43
270	-13	-18	-1.48	32	22	39
300	•	•	•	•	•	•
330	•	•	•	•	•	•
360	•	•	•	•	•	•
390	•	•	•	•	•	•
420	•	•	•	•	•	•
450	•	•	•	•	•	•
480	•	•	•	•	•	•
510	•	•	•	•	•	•
540	•	•	•	•	•	•
570	•	•	•	•	•	•
600	•	•	•	•	•	•
630	•	•	•	•	•	•
660	•	•	•	•	•	•
690	•	•	•	•	•	•
720	•	•	•	•	•	•
750	•	•	•	•	•	•
780	•	•	•	•	•	•
810	•	•	•	•	•	•
840	•	•	•	•	•	•
870	•	•	•	•	•	•
900	•	•	•	•	•	•
930	•	•	•	•	•	•
960	•	•	•	•	•	•
990	•	•	•	•	•	•
1020	•	•	•	•	•	•
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 60 mmHg

Subject mrp

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	1	-3	-0.10	51	56	49
60	-7	-9	-0.66	70	76	67
90	-8	-10	-0.72	61	63	61
120	-5	-14	-0.79	67	72	66
150	-4	-15	-0.78	66	70	66
180	-5	-17	-0.86	66	67	66
210	-11	-13	-0.96	61	61	61
240	-6	-17	-0.90	68	70	67
270	-4	-17	-0.87	64	68	65
300	-1	-22	-0.94	65	64	66
330	-5	-22	-1.03	66	65	66
360	-2	-22	-0.97	67	66	68
390	-4	-21	-1.01	63	62	65
420	-4	-23	-1.06	65	62	66
450	-6	-20	-1.04	61	57	63
480	-6	-23	-1.12	65	61	66
510	-6	-24	-1.16	65	64	67
540	-4	-25	-1.13	66	62	67
570	-4	-24	-1.12	66	65	68
600	1	-26	-1.04	66	65	68
630	-6	-26	-1.23	67	67	68
660	-3	-27	-1.19	62	58	65
690	-4	-26	-1.16	59	54	63
720	-1	-29	-1.21	66	59	69
750	-4	-27	-1.22	62	58	65
780	-1	-28	-1.18	66	60	69
810	-3	-28	-1.24	63	56	67
840	-1	-29	-1.22	70	68	73
870	-1	-30	-1.25	68	65	71
900	0	-31	-1.27	70	67	72
930	0	-32	-1.28	68	64	72
960	2	-31	-1.18	67	61	71
990	-2	-30	-1.28	65	58	69
1020	0	-32	-1.30	69	62	72
1050	-2	-30	-1.28	67	61	70
1080	2	-33	-1.27	71	66	75
1110	-1	-31	-1.32	68	61	72
1140	0	-32	-1.31	63	53	67
1170	-3	-30	-1.33	60	49	65
1200	2	-29	-1.11	59	52	63

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 60 mmHg
Subject mrp

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	-5	-19	-0.96	41	55	40
60	-12	-15	-1.12	45	54	45
90	-12	-16	-1.20	42	48	44
120	-12	-20	-1.34	44	49	47
150	-10	-21	-1.28	43	45	47
180	-5	-26	-1.27	45	46	49
210	-4	-30	-1.38	42	44	47
240	-4	-29	-1.35	42	37	48
270	-7	-30	-1.50	45	43	49
300	-6	-31	-1.50	41	33	47
330	-6	-30	-1.45	42	37	48
360	-7	-32	-1.58	44	39	49
390	-8	-28	-1.48	40	33	46
420	-8	-14	-1.05	40	30	46
450	-7	-31	-1.53	41	31	47
480	-5	-33	-1.53	41	33	47
510	-5	-35	-1.61	40	33	46
540	-5	-34	-1.59	40	27	47
570	-6	-34	-1.58	38	26	45
600	-6	-34	-1.62	39	22	46
630	-7	-33	-1.59	39	26	46
660	-4	-35	-1.62	41	29	48
690	-6	-34	-1.61	39	26	46
720	-4	-37	-1.67	38	21	46
750	-6	-35	-1.66	40	25	47
780	-4	-38	-1.67	39	19	48
810	-8	-36	-1.75	38	28	45
840	-3	-38	-1.66	40	22	47
870	-4	-40	-1.79	39	22	46
900	-1	-40	-1.71	39	16	48
930	-3	-39	-1.71	37	15	46
960	0	-41	-1.67	42	22	50
990	-3	-39	-1.74	38	18	47
1020	0	-42	-1.76	40	15	48
1050	0	-42	-1.77	39	14	48
1080	-2	-42	-1.80	43	20	51
1110	-1	-42	-1.81	39	19	48
1140	3	-45	-1.81	44	24	52
1170	-2	-40	-1.74	41	21	49
1200	3	-41	-1.57	48	33	55

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 70 mmHg

Subject mrp

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	2	-5	-0.13	46	47	48
60	-11	-4	-0.59	66	69	64
90	-10	-7	-0.64	60	65	60
120	-9	-9	-0.66	62	64	63
150	-9	-10	-0.69	64	68	65
180	-9	-11	-0.73	63	66	64
210	-6	-15	-0.74	65	67	68
240	0	-21	-0.76	70	71	72
270	-7	-17	-0.85	65	69	67
300	-4	-19	-0.81	69	71	72
330	-4	-20	-0.86	68	72	70
360	-4	-18	-0.78	73	77	74
390	-2	-22	-0.86	68	71	70
420	2	-25	-0.84	71	72	74
450	-1	-23	-0.86	70	73	74
480	1	-25	-0.86	72	75	75
510	-2	-21	-0.84	69	71	73
540	0	-24	-0.85	72	71	76
570	-1	-24	-0.88	70	69	74
600	3	-26	-0.86	72	72	76
630	1	-25	-0.86	71	72	76
660	5	-29	-0.88	73	71	78
690	4	-28	-0.89	74	74	79
720	7	-30	-0.88	73	68	79
750	5	-29	-0.89	74	70	80
780	4	-29	-0.94	76	75	80
810	3	-27	-0.89	73	68	79
840	4	-28	-0.89	74	68	80
870	5	-28	-0.86	76	73	82
900	5	-30	-0.92	76	70	81
930	4	-29	-0.93	78	73	83
960	4	-28	-0.86	77	72	83
990	5	-28	-0.87	77	72	83
1020	3	-28	-0.91	76	70	81
1050	3	-29	-0.93	74	69	79
1080	6	-29	-0.87	71	59	78
1110	5	-30	-0.95	74	66	80
1140	7	-31	-0.91	74	64	80
1170	4	-29	-0.93	74	71	80
1200	7	-18	-0.41	67	62	71

Change in cardiac parameters
Ground level PPB

Garment:	EAGLE							
PPB	70 mmHg							
Subject	mrp	HR	SV	CI	MAP	SBP	DBP	
		bpm	ml	l/min/m ²	mmHg	mmHg	mmHg	
Time (s)								
		30	3	-8	-0.16	52	59	56
		60	-2	-6	-0.28	65	71	66
		90	-1	-8	-0.34	58	63	61
		120	2	-11	-0.35	61	63	65
		150	6	-15	-0.34	58	57	62
		180	10	-17	-0.29	60	58	65
		210	8	-16	-0.32	58	56	63
		240	7	-17	-0.40	61	59	66
		270	10	-18	-0.35	58	57	63
		300	12	-22	-0.45	60	56	66
		330	12	-20	-0.38	57	56	63
		360	13	-19	-0.27	57	51	64
		390	13	-23	-0.45	56	52	63
		420	12	-22	-0.41	57	52	64
		450	13	-23	-0.46	58	55	63
		480	15	-25	-0.48	59	54	65
		510	17	-26	-0.46	56	54	63
		540	18	-26	-0.44	59	53	66
		570	17	-27	-0.52	54	52	62
		600	17	-27	-0.47	57	48	65
		630	13	-26	-0.58	55	45	64
		660	20	-28	-0.47	59	50	66
		690	16	-27	-0.55	55	45	64
		720	20	-27	-0.46	56	45	65
		750	18	-27	-0.48	57	46	66
		780	20	-29	-0.51	57	48	66
		810	17	-28	-0.55	53	42	61
		840	24	-31	-0.50	57	45	66
		870	21	-30	-0.56	58	48	66
		900	23	-31	-0.52	57	50	65
		930	24	-33	-0.62	51	37	61
		960	28	-31	-0.44	58	44	67
		990	31	-34	-0.50	58	46	67
		1020	27	-34	-0.59	57	40	67
		1050	26	-34	-0.62	56	41	65
		1080	31	-36	-0.57	56	34	67
		1110	29	-35	-0.58	53	31	65
		1140	25	-35	-0.70	52	28	64
		1170	26	-35	-0.66	53	30	64
		1200	24	-29	-0.41	48	28	56

Change in cardiac parameters
Ground level PPB

Garment: TLSS
PPB 70 mmHg
Subject mrp

	HR	SV	CI	MAP	SBP	DBP
Subject	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	3	-8	-0.16	42	46	46
60	-2	-6	-0.28	56	61	58
90	-1	-8	-0.34	54	58	57
120	2	-11	-0.35	58	59	61
150	6	-15	-0.34	54	53	59
180	10	-17	-0.29	57	55	61
210	8	-16	-0.32	57	56	60
240	7	-17	-0.40	60	59	63
270	10	-18	-0.35	56	52	61
300	12	-22	-0.45	60	59	63
330	12	-20	-0.38	55	50	59
360	13	-19	-0.27	61	60	65
390	13	-23	-0.45	56	53	61
420	12	-22	-0.41	57	51	62
450	13	-23	-0.46	54	44	60
480	15	-25	-0.48	59	51	65
510	17	-26	-0.46	54	43	61
540	18	-26	-0.44	64	57	69
570	17	-27	-0.52	59	50	65
600	17	-27	-0.47	63	54	68
630	13	-26	-0.58	60	50	66
660	20	-28	-0.47	62	54	67
690	16	-27	-0.55	61	56	66
720	20	-27	-0.46	61	51	67
750	18	-27	-0.48	59	49	65
780	20	-29	-0.51	61	49	66
810	17	-28	-0.55	59	49	65
840	24	-31	-0.50	63	53	69
870	21	-30	-0.56	62	49	69
900	23	-31	-0.53	64	51	70
930	24	-33	-0.62	58	45	65
960	28	-31	-0.44	69	62	74
990	31	-34	-0.50	60	44	67
1020	27	-34	-0.59	64	51	72
1050	26	-34	-0.62	63	50	70
1080	31	-36	-0.57	61	43	68
1110	29	-35	-0.58	61	44	69
1140	25	-35	-0.70	67	53	74
1170	26	-35	-0.66	65	51	72
1200	24	-29	-0.41	60	52	64

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 80 mmHg

Subject mrp

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	0	-11	-0.43	57	64	58
60	-11	-8	-0.74	65	75	65
90	-11	-11	-0.87	61	67	63
120	-8	-13	-0.79	66	68	68
150	-5	-18	-0.90	62	63	65
180	-3	-20	-0.94	70	68	73
210	-4	-19	-0.91	61	64	65
240	3	-25	-0.96	70	66	74
270	6	-28	-0.98	61	55	68
300	4	-29	-1.07	66	61	72
330	3	-28	-1.08	61	56	67
360	8	-32	-1.08	66	59	72
390	6	-31	-1.09	62	55	68
420	8	-30	-1.09	68	61	74
450	7	-30	-1.10	64	59	71
480	5	-26	-1.05	66	59	72
510	9	-34	-1.17	63	55	71
540	8	-31	-1.10	65	58	71
570	10	-35	-1.20	63	55	70
600	4	-28	-1.10	64	58	71
630	-12	-21	-1.26	65	61	70
660	-5	-11	-0.86	69	62	72
690	-1	-30	-1.28	66	61	72
720	3	-31	-1.22	72	65	77
750	9	-33	-1.25	69	61	75
780	14	-32	-1.14	69	62	75
810	16	-36	-1.12	66	57	74
840	11	-32	-1.13	67	57	74
870	10	-29	-1.23	66	55	73
900	10	-32	-1.21	67	56	74
930	11	-36	-1.30	64	54	72
960	10	-37	-1.29	67	55	75
990	5	-29	-1.26	63	50	71
1020	10	-29	-1.11	66	54	74
1050	15	-35	-1.20	63	47	72
1080	17	-33	-1.10	64	50	73
1110	16	-33	-1.08	59	42	69
1140	15	-37	-1.22	65	49	74
1170	14	-35	-1.26	60	43	70
1200	12	-23	-0.83	50	35	56

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 80 mmHg
Subject mrp

	HR bpm	SV ml	Cl l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	10	-14	-0.41	58	59	62
60	-8	-10	-0.57	67	77	70
90	-1	-15	-0.63	65	71	70
120	11	-18	-0.60	65	64	72
150	9	-18	-0.63	64	66	70
180	4	-18	-0.71	68	72	73
210	1	-18	-0.72	68	72	74
240	7	-21	-0.76	68	69	73
270	5	-20	-0.76	69	70	75
300	7	-17	-0.58	70	75	75
330	7	-20	-0.74	66	71	72
360	8	-20	-0.73	68	68	74
390	7	-21	-0.76	65	61	72
420	10	-22	-0.80	70	67	76
450	10	-22	-0.77	68	63	76
480	7	-22	-0.82	70	67	76
510	9	-22	-0.82	68	67	75
540	19	-24	-0.80	67	64	74
570	23	-22	-0.75	69	67	76
600	22	-24	-0.76	71	70	78
630	14	-25	-0.87	74	75	80
660	14	-24	-0.85	69	61	77
690	18	-25	-0.86	70	60	79
720	16	-25	-0.85	71	59	79
750	21	-26	-0.86	71	61	80
780	24	-26	-0.86	70	55	79
810	21	-26	-0.89	69	57	78
840	28	-27	-0.88	70	54	80
870	23	-26	-0.87	68	53	77
900	25	-26	-0.85	68	59	77
930	29	-27	-0.87	69	58	78
960	28	-28	-0.89	71	58	80
990	32	-28	-0.86	65	49	76
1020	31	-28	-0.88	71	51	82
1050	29	-28	-0.90	67	47	78
1080	36	-28	-0.85	70	50	80
1110	40	-28	-0.77	65	46	75
1140	39	-29	-0.87	69	49	79
1170	24	-28	-0.93	66	46	77
1200	34	-25	-0.68	61	35	73

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 60 mmHg

Subject twg

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	-16	16	0.06	27	27	26
60	-21	16	-0.10	33	36	30
90	-21	18	-0.04	41	50	38
120	-20	10	-0.24	37	39	35
150	-15	8	-0.17	36	32	35
180	-17	9	-0.17	38	35	37
210	-12	3	-0.24	37	31	37
240	-9	1	-0.19	39	33	40
270	-8	1	-0.16	38	31	39
300	-7	1	-0.14	39	32	40
330	-10	1	-0.24	35	27	36
360	-7	-1	-0.23	38	31	39
390	-7	-2	-0.27	36	26	38
420	-7	-2	-0.26	46	42	46
450	-5	-2	-0.23	40	32	43
480	-5	-2	-0.21	45	36	45
510	-9	-1	-0.28	40	32	41
540	-2	-4	-0.19	43	30	45
570	-6	-1	-0.19	41	32	43
600	-3	-5	-0.28	45	34	48
630	-4	-5	-0.31	43	32	46
660	-2	-4	-0.22	47	35	49
690	-7	-5	-0.35	45	36	47
720	-3	-4	-0.23	49	40	50
750	-5	-4	-0.27	45	34	47
780	-5	-3	-0.21	44	33	46
810	-5	-3	-0.22	46	37	47
840	-4	-4	-0.24	46	34	48
870	-4	-3	-0.21	45	33	47
900	-2	-5	-0.21	47	34	49
930	-7	-3	-0.28	46	35	47
960	-4	-5	-0.29	51	42	52
990	-9	0	-0.25	51	43	50
1020	-5	-4	-0.28	55	45	56
1050	-8	-1	-0.27	51	42	51
1080	-5	-3	-0.21	52	43	53
1110	-8	0	-0.23	49	42	50
1140	-1	-6	-0.27	46	34	48
1170	-4	14	0.30	54	48	54
1200	2	19	0.86	39	32	39

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 60 mmHg
Subject twg

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-16	3	-0.40	23	15	23
60	-14	-3	-0.52	28	21	30
90	-12	-3	-0.49	29	24	32
120	-8	-4	-0.40	31	24	33
150	-6	-6	-0.42	28	19	31
180	-5	-4	-0.28	34	24	37
210	-7	-2	-0.32	34	22	36
240	-4	-5	-0.35	38	28	40
270	-10	-1	-0.35	36	26	37
300	-7	-3	-0.32	37	26	38
330	-9	-1	-0.30	36	23	38
360	-4	-6	-0.38	37	24	39
390	-7	-3	-0.34	37	22	39
420	-6	-7	-0.43	40	28	41
450	-8	-7	-0.48	36	22	39
480	-5	-6	-0.38	39	27	41
510	-11	-6	-0.55	38	29	38
540	-6	-5	-0.37	41	31	41
570	-5	-6	-0.40	38	28	39
600	-6	-4	-0.33	36	20	38
630	-9	-5	-0.44	36	22	38
660	-2	-8	-0.39	36	19	39
690	-3	-9	-0.44	32	15	36
720	-4	-8	-0.45	36	20	38
750	-3	-9	-0.43	31	12	35
780	0	-10	-0.41	40	22	43
810	1	-12	-0.44	41	27	44
840	4	-13	-0.41	33	12	38
870	1	-11	-0.43	36	18	41
900	5	-12	-0.38	37	18	41
930	-1	-10	-0.45	37	22	41
960	4	-11	-0.37	39	21	43
990	5	-12	-0.40	36	16	42
1020	5	-14	-0.47	41	25	45
1050	1	-11	-0.42	43	29	46
1080	4	-13	-0.43	41	27	45
1110	0	-11	-0.46	41	22	44
1140	6	-14	-0.46	41	25	45
1170	4	-12	-0.39	40	22	45
1200	5	5	0.46	30	18	31

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 70 mmHg

Subject twg

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	-18	27	0.27	27	31	27
60	-15	22	0.26	36	40	36
90	-11	18	0.25	38	41	37
120	-10	17	0.28	39	39	39
150	-7	13	0.25	40	39	39
180	-5	10	0.23	41	37	41
210	-4	5	0.10	40	37	41
240	-5	8	0.17	44	38	44
270	-4	6	0.14	43	39	43
300	-3	8	0.21	44	37	44
330	0	4	0.14	42	36	44
360	2	-1	0.01	40	30	43
390	-1	3	0.09	44	39	45
420	0	3	0.13	45	34	47
450	-1	0	-0.01	42	32	45
480	-1	0	-0.04	43	31	45
510	-3	4	0.09	45	38	46
540	-2	3	0.05	43	33	45
570	-2	2	-0.01	43	36	45
600	-1	5	0.19	45	39	47
630	-1	3	0.09	44	37	46
660	-1	0	-0.01	45	35	48
690	-4	1	-0.06	46	38	48
720	2	0	0.05	44	31	47
750	0	10	0.48	45	36	47
780	-2	-2	-0.10	48	41	50
810	-7	0	-0.16	45	38	47
840	3	-4	-0.06	43	30	47
870	-4	-3	-0.17	46	37	49
900	1	-3	-0.08	43	30	47
930	-1	-5	-0.20	48	39	50
960	-3	0	-0.08	48	40	50
990	1	-2	-0.03	45	32	48
1020	7	-1	0.13	47	33	51
1050	-1	0	-0.05	49	38	51
1080	3	-3	-0.02	48	33	51
1110	-1	31	0.99	51	40	53
1140	1	15	0.58	52	41	55
1170	3	-5	-0.12	50	41	53
1200	7	18	0.93	43	33	45

Change in cardiac parameters
Ground level PPB

Garment: EAGLE

PPB 70 mmHg

Subject twg

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-13	-6	-0.61	30	35	33
60	-17	-11	-0.92	38	47	40
90	-13	-9	-0.71	35	37	38
120	-11	-14	-0.86	37	34	40
150	-12	-17	-1.00	38	41	39
180	-12	-14	-0.84	38	33	42
210	-5	-16	-0.77	40	36	44
240	2	-20	-0.78	41	35	45
270	11	-20	-0.53	37	22	43
300	7	-19	-0.63	40	25	47
330	7	-21	-0.72	36	16	45
360	3	-22	-0.85	35	17	42
390	11	-23	-0.70	29	•	38
420	9	-27	-0.90	28	•	38
450	15	-24	-0.63	24	•	34
480	17	-22	-0.53	25	•	35
510	14	-21	-0.57	25	•	35
540	19	-24	-0.57	25	•	35
570	16	-24	-0.62	21	•	31
600	22	-22	-0.40	20	•	30
630	16	-20	-0.45	26	•	35
660	26	-24	-0.41	27	•	36
690	21	-23	-0.51	22	•	33
720	25	-25	-0.50	20	•	31
750	21	•	•	17	•	28
780	23	•	•	17	•	27
810	18	•	•	18	•	28
840	11	•	•	21	•	31
870	17	•	•	20	•	31
900	•	•	•	21	•	30
930	•	•	•	27	•	35
960	•	•	•	25	•	32
990	•	•	•	20	•	26
1020	•	•	•	22	•	25
1050	•	•	•	21	•	22
1080	•	•	•	17	•	17
1110	•	•	•	21	•	15
1140	•	•	•	21	•	29
1170	•	•	•	30	•	39
1200	•	•	•	17	•	21

Change in cardiac parameters
Ground level PPB

Garment: TLSS
PPB 70 mmHg
Subject twg

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-10	19	-0.41	41	32	42
60	-8	18	-0.27	50	50	50
90	-7	12	-0.36	47	45	47
120	-11	23	-0.41	50	46	49
150	-5	26	0.40	47	40	48
180	-3	-2	-0.47	48	40	49
210	-4	0	-0.50	45	33	47
240	-4	-8	-0.73	57	54	55
270	-1	-19	-0.93	54	53	53
300	6	2	0.61	51	45	52
330	0	-17	-0.71	44	37	46
360	1	-14	-0.47	45	32	48
390	0	-14	-0.54	45	31	48
420	5	-22	-0.40	47	34	49
450	3	-25	-0.71	44	25	48
480	9	-26	-0.18	43	21	48
510	3	-25	-0.69	45	29	49
540	5	-29	-0.73	44	25	48
570	17	-25	0.60	44	24	49
600	6	-25	-0.49	45	24	50
630	9	-34	-0.57	46	25	51
660	6	-33	-0.78	51	32	55
690	12	-37	-0.48	50	33	55
720	12	-39	-0.55	48	26	53
750	7	-36	-0.84	45	21	50
780	15	-36	0.10	47	25	51
810	12	-35	0.10	46	28	50
840	11	-38	-0.59	43	18	49
870	14	-46	-0.63	45	22	52
900	16	-33	0.10	44	20	49
930	15	-37	0.10	46	25	51
960	18	-49	0.10	44	16	50
990	13	-50	-0.85	47	26	53
1020	20	-51	0.10	45	18	51
1050	23	-42	0.32	46	24	51
1080	24	-54	0.10	47	20	53
1110	25	-48	0.17	51	30	56
1140	26	-64	-0.59	51	26	57
1170	26	-59	0.10	49	25	55
1200	18	-37	0.04	38	19	41

Change in cardiac parameters
Ground level PPB

Garment: ATAGS
 PPB 80 mmHg
 Subject twg

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	-22	11	-0.19	37	36	39
60	-27	10	-0.36	45	49	46
90	-18	5	-0.28	47	48	49
120	-12	0	-0.27	50	50	52
150	-9	-1	-0.27	53	49	56
180	-8	-1	-0.21	54	50	57
210	-6	-1	-0.20	58	53	60
240	-7	-5	-0.35	60	54	62
270	-6	-6	-0.38	59	54	62
300	-4	-6	-0.34	63	55	66
330	-2	-4	-0.24	60	52	63
360	-6	-4	-0.33	62	57	64
390	-6	3	-0.17	60	56	63
420	-5	-5	-0.33	62	54	65
450	-11	3	-0.10	60	54	63
480	-6	-8	-0.45	60	48	64
510	-5	0	-0.16	62	54	66
540	-9	-1	-0.31	65	60	66
570	-8	-8	-0.50	61	52	64
600	-9	-2	-0.32	62	54	65
630	-5	-12	-0.60	66	58	69
660	-5	-12	-0.63	65	57	68
690	-4	-2	-0.12	65	56	68
720	-7	-3	-0.29	68	61	71
750	-2	-10	-0.47	66	59	70
780	-5	-11	-0.55	65	56	69
810	-6	-12	-0.64	69	63	72
840	-3	-6	-0.30	67	60	71
870	-1	-10	-0.44	66	57	71
900	-4	-11	-0.54	66	58	70
930	-1	-12	-0.55	66	56	70
960	-1	-8	-0.35	67	58	72
990	-5	-11	-0.59	69	62	73
1020	0	-15	-0.63	70	60	75
1050	-5	-9	-0.43	70	62	74
1080	-4	-13	-0.60	76	66	79
1110	-2	-10	-0.49	74	63	78
1140	0	-8	-0.34	70	56	75
1170	0	-10	-0.50	69	54	75
1200	2	-13	-0.55	62	42	69

Change in cardiac parameters
Ground level PPB

Garment: EAGLE

PPB 80 mmHg

Subject twg

	HR	SV	Cl	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	-8	-13	-0.73	44	38	52
60	-5	-22	-1.01	53	49	64
90	-1	-19	-0.81	54	46	65
120	-4	-18	-0.85	53	39	63
150	3	-17	-0.66	54	39	65
180	7	-17	-0.54	57	42	67
210	3	-21	-0.80	59	44	70
240	6	-25	-0.94	58	42	69
270	8	-22	-0.77	57	39	67
300	7	-26	-0.96	59	41	70
330	4	-24	-0.93	57	38	69
360	8	-27	-0.98	59	42	70
390	8	-25	-0.94	59	45	69
420	5	-27	-1.04	56	37	68
450	7	-24	-0.87	57	39	70
480	-2	-24	-1.04	56	39	66
510	-2	-27	-1.14	60	48	69
540	4	-28	-1.14	55	35	67
570	10	-27	-0.98	58	35	70
600	8	-24	-0.86	60	39	72
630	6	-27	-1.06	62	45	72
660	10	-29	-1.07	64	45	75
690	8	-25	-0.92	59	37	70
720	8	-27	-1.00	59	38	69
750	10	-27	-0.98	50	22	63
780	10	-22	-0.78	54	28	66
810	9	-29	-1.06	56	28	69
840	11	-25	-0.91	57	32	69
870	17	-25	-0.72	52	25	63
900	14	-27	-0.91	53	26	65
930	19	-29	-0.91	53	24	64
960	13	-12	-0.26	57	32	67
990	22	-30	-0.93	52	23	63
1020	19	-17	-0.59	53	23	64
1050	19	-19	-0.66	52	22	62
1080	18	-26	-0.85	51	21	62
1110	27	-31	-0.97	49	17	60
1140	16	-18	-0.63	54	24	65
1170	18	-4	0.22	62	34	72
1200	14	-6	0.09	58	34	69

Change in cardiac parameters
Ground level PPB

Garment:	ATAGS	HR	SV	CI	MAP	SBP	DBP
PPB	60 mmHg	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Subject	wdf						
		Time (s)					
		30	4	-10	-0.25	48	48
		60	-5	-6	-0.44	57	65
		90	0	-7	-0.32	56	65
		120	-2	-8	-0.37	53	59
		150	-3	-6	-0.42	54	62
		180	6	-8	-0.28	55	61
		210	7	-16	-0.45	58	62
		240	19	-22	-0.45	57	60
		270	23	-24	-0.45	56	59
		300	21	-27	-0.54	58	61
		330	20	-27	-0.59	58	59
		360	19	-25	-0.54	59	62
		390	19	-25	-0.58	59	61
		420	16	-29	-0.76	58	60
		450	19	-27	-0.64	56	57
		480	21	-28	-0.62	58	59
		510	19	-29	-0.69	52	52
		540	15	-26	-0.64	53	52
		570	15	-30	-0.84	44	32
		600	11	-22	-0.66	49	43
		630	12	-25	-0.68	47	44
		660	13	-26	-0.67	44	40
		690	10	-24	-0.74	43	35
		720	8	-27	-0.88	51	47
		750	12	-25	-0.71	48	45
		780	12	-28	-0.80	49	46
		810	9	-27	-0.85	50	48
		840	9	-26	-0.79	52	50
		870	12	-28	-0.82	48	44
		900	10	-25	-0.74	48	45
		930	11	-27	-0.78	50	46
		960	11	-25	-0.73	50	47
		990	10	•	•	47	43
		1020	6	•	•	45	40
		1050	6	•	•	41	32
		1080	7	•	•	46	40
		1110	6	•	•	46	43
		1140	8	•	•	48	40
		1170	9	•	•	48	45
		1200	11	•	•	42	39

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 60 mmHg
Subject wdf

	HR	SV	CI	MAP	SBP	DBP
	bpm	ml	l/min/m ²	mmHg	mmHg	mmHg
Time (s)						
30	11	-7	0.01	53	57	51
60	2	1	-0.07	60	67	58
90	10	-9	-0.04	54	61	54
120	11	-9	-0.04	59	64	58
150	14	-12	-0.06	62	70	60
180	15	-10	0.00	64	70	63
210	18	-15	-0.11	61	66	61
240	19	-16	-0.14	60	65	60
270	18	-16	-0.16	59	62	58
300	19	-18	-0.20	64	70	63
330	20	-19	-0.25	59	65	57
360	17	-13	-0.06	55	55	55
390	19	-4	0.41	56	57	56
420	20	-7	0.30	56	58	56
450	20	-12	0.06	60	63	59
480	22	-3	0.55	64	70	63
510	21	-15	-0.05	65	71	64
540	18	-12	0.03	63	67	62
570	19	-16	-0.13	63	70	62
600	19	-12	0.07	60	62	60
630	19	-6	0.32	63	68	63
660	23	-11	0.16	81	88	78
690	19	-17	-0.16	81	88	79
720	17	-11	0.06	77	82	76
750	18	-9	0.15	72	76	72
780	19	-12	0.04	72	77	72
810	19	-2	0.47	67	68	68
840	18	-6	0.28	72	72	72
870	19	-18	-0.23	77	84	75
900	16	-17	-0.23	68	68	69
930	17	-20	-0.35	78	82	77
960	15	2	0.54	75	79	73
990	16	-8	0.16	69	73	69
1020	17	0	0.56	70	72	70
1050	17	-17	-0.23	68	70	69
1080	17	-14	-0.10	65	66	66
1110	18	-17	-0.20	64	63	65
1140	18	-15	-0.13	62	62	63
1170	18	-14	-0.07	66	70	66
1200	19	-12	0.03	76	81	74

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 70 mmHg

Subject wdf

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	9	-10	-0.19	59	50	61
60	7	-24	-0.76	68	67	69
90	2	-17	-0.64	68	67	70
120	2	-24	-0.87	67	63	69
150	7	-42	-1.39	70	65	72
180	16	-46	-1.41	62	57	65
210	17	-44	-1.38	69	61	73
240	19	-46	-1.35	63	55	67
270	18	-47	-1.42	63	55	68
300	19	-49	-1.50	65	59	68
330	16	-49	-1.54	63	57	67
360	15	-49	-1.58	63	56	68
390	18	-53	-1.68	65	53	70
420	11	-51	-1.71	64	57	69
450	15	-52	-1.69	65	58	69
480	21	-47	-1.32	60	51	65
510	18	-50	-1.58	61	50	66
540	16	-49	-1.59	57	47	62
570	16	-53	-1.74	61	52	67
600	14	-48	-1.54	62	54	66
630	15	-55	-1.83	63	53	68
660	19	-50	-1.52	59	49	64
690	16	-45	-1.37	60	52	65
720	12	-47	-1.52	60	54	65
750	12	-50	-1.65	58	49	63
780	14	-44	-1.38	61	55	65
810	11	-41	-1.25	64	58	68
840	13	-12	0.09	58	52	62
870	15	-45	-1.39	59	50	64
900	11	-42	-1.29	55	50	60
930	10	-49	-1.62	58	51	63
960	4	-36	-1.24	58	51	63
990	7	1	0.36	63	58	68
1020	13	-23	-0.44	57	52	62
1050	13	-5	0.31	60	53	65
1080	12	-8	0.09	59	53	63
1110	12	-29	-0.74	58	50	63
1140	5	-30	-0.98	57	51	61
1170	12	-35	-0.98	55	48	61
1200	8	-2	0.34	57	53	61

Change in cardiac parameters
Ground level PPB

Garment:	EAGLE		HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
PPB	70 mmHg							
Subject	wdf		Time (s)					
			30	19	-21	-0.42	58	58
			60	9	-18	-0.54	79	84
			90	7	-12	-0.47	80	86
			120	3	-15	-0.64	79	86
			150	5	-20	-0.79	88	95
			180	14	-25	-0.82	84	87
			210	16	-36	-1.18	85	93
			240	15	-35	-1.19	88	93
			270	16	-35	-1.15	88	95
			300	14	-35	-1.18	82	83
			330	15	-35	-1.29	81	85
			360	13	-35	-1.21	80	80
			390	17	-42	-1.50	82	84
			420	15	-39	-1.40	86	90
			450	16	-43	-1.54	90	96
			480	17	-43	-1.50	94	101
			510	15	-44	-1.61	84	86
			540	10	-39	-1.46	89	91
			570	13	-43	-1.56	87	92
			600	11	-41	-1.55	89	94
			630	12	-44	-1.67	85	90
			660	11	-39	-1.49	91	94
			690	5	-31	-1.27	84	92
			720	4	-36	-1.46	89	95
			750	4	-40	-1.59	92	98
			780	11	-45	-1.70	89	91
			810	12	-46	-1.74	90	91
			840	13	-48	-1.81	96	100
			870	17	-46	-1.67	92	95
			900	12	-40	-1.48	91	89
			930	15	-47	-1.74	97	101
			960	12	-47	-1.78	96	100
			990	10	-46	-1.76	96	100
			1020	9	-45	-1.71	92	90
			1050	11	-46	-1.76	91	91
			1080	11	-47	-1.79	88	83
			1110	11	-48	-1.85	88	85
			1140	11	-46	-1.77	90	86
			1170	14	-50	-1.89	91	92
			1200	14	-36	-1.27	84	87

Change in cardiac parameters
Ground level PPB

Garment: TLSS

PPB 70 mmHg

Subject wdf

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	13	-28	-0.04	57	57	56
60	7	20	0.86	64	71	63
90	3	-21	-0.48	62	72	62
120	14	-32	-0.22	67	71	67
150	16	-33	-0.15	63	69	64
180	9	-29	-0.27	63	70	64
210	6	-22	-0.28	64	71	65
240	27	-45	-0.05	67	74	68
270	21	-44	-0.28	60	67	61
300	36	-55	-0.05	64	70	65
330	30	-52	0.02	60	64	61
360	30	-25	1.01	59	61	61
390	31	-13	1.64	61	66	63
420	32	35	3.54	66	73	66
450	39	32	3.68	60	66	61
480	32	40	3.55	64	69	64
510	24	72	4.75	63	70	64
540	53	62	4.42	62	67	63
570	30	72	5.09	62	67	64
600	30	68	4.04	63	68	64
630	39	33	3.87	60	65	61
660	45	54	4.64	61	64	63
690	45	74	5.51	61	67	63
720	39	62	4.57	62	66	63
750	38	•	7.12	61	66	63
780	48	63	5.10	62	65	64
810	43	•	6.78	60	64	62
840	39	•	5.64	58	57	61
870	36	72	5.78	58	62	60
900	53	39	4.35	61	64	63
930	52	37	4.83	63	67	64
960	47	47	3.34	64	70	66
990	47	23	4.05	62	66	64
1020	58	16	3.64	61	63	63
1050	52	•	7.23	61	64	62
1080	51	62	5.44	63	69	64
1110	41	•	7.78	57	60	59
1140	51	97	6.67	59	59	61
1170	45	47	4.11	59	64	60
1200	46	16	2.58	53	56	52

Change in cardiac parameters
Ground level PPB

Garment: ATAGS

PPB 80 mmHg

Subject wdf

	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
Time (s)						
30	13	-3	0.05	72	71	73
60	31	-11	-0.29	81	76	80
90	24	-3	0.10	82	87	83
120	13	14	0.97	81	82	82
150	16	10	0.77	80	80	82
180	7	24	1.55	78	74	82
210	8	20	1.38	76	70	79
240	7	25	1.78	75	65	80
270	8	28	2.07	74	66	80
300	13	22	1.73	74	61	80
330	6	23	1.76	78	67	84
360	3	30	1.97	78	70	82
390	6	27	2.04	78	67	83
420	5	20	1.59	72	59	78
450	6	19	1.53	78	66	84
480	9	20	1.63	73	60	80
510	7	21	1.66	72	58	79
540	7	14	1.24	73	57	80
570	9	17	1.51	69	53	76
600	7	20	1.59	73	61	80
630	12	17	1.54	72	57	80
660	12	17	1.51	67	48	75
690	12	13	1.34	70	52	78
720	12	26	2.09	70	52	78
750	12	14	1.36	71	53	78
780	12	17	1.50	71	54	78
810	9	20	1.60	66	46	74
840	5	17	1.46	65	48	72
870	.	15	1.55	117	118	119
900	.	14	1.50	113	113	115
930	.	18	1.67	109	109	112
960	.	8	1.39	116	115	117
990	.	26	2.06	113	112	115
1020	.	17	1.69	116	116	117
1050	.	25	2.01	108	107	110
1080	.	25	2.03	114	113	116
1110	.	21	1.77	112	110	114
1140	.	20	1.75	118	116	119
1170	.	11	1.33	119	119	121
1200	.	10	1.09	112	117	110

Change in cardiac parameters
Ground level PPB

Garment: EAGLE
PPB 80 mmHg
Subject wdf

Time (s)	HR bpm	SV ml	CI l/min/m ²	MAP mmHg	SBP mmHg	DBP mmHg
30	46	-5	0.73	63	58	61
60	56	-11	0.36	68	72	68
90	58	-17	0.26	61	61	62
120	70	-6	0.93	63	63	65
150	87	-16	0.70	56	54	59
180	73	-7	0.83	60	54	62
210	64	-1	0.98	56	53	59
240	61	4	1.39	59	57	62
270	69	-1	1.30	65	65	68
300	61	-4	1.18	69	73	71
330	62	8	1.75	68	65	71
360	64	-4	1.05	68	63	71
390	53	13	1.62	69	66	71
420	26	42	2.57	80	78	82
450	47	14	1.77	82	81	85
480	62	5	1.54	87	85	90
510	•	-33	2.24	107	105	109
540	•	-17	2.04	103	101	106
570	38	20	1.94	111	111	113
600	47	11	1.68	116	119	118
630	44	16	1.82	110	111	113
660	38	14	1.59	110	108	112
690	42	18	1.87	108	108	109
720	41	15	1.71	107	107	109
750	41	13	1.66	109	108	111
780	41	16	1.77	116	117	117
810	43	14	1.61	108	108	110
840	26	29	2.13	119	117	119
870	•	•	•	•	•	•
900	•	•	•	•	•	•
930	•	•	•	•	•	•
960	•	•	•	•	•	•
990	•	•	•	•	•	•
1020	•	•	•	•	•	•
1050	•	•	•	•	•	•
1080	•	•	•	•	•	•
1110	•	•	•	•	•	•
1140	•	•	•	•	•	•
1170	•	•	•	•	•	•
1200	•	•	•	•	•	•

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